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Grafting Experiment Between Different Plant Species: Jackfruit (*Artocarpus heterophyllus*) and Durian (*Durio zibethinus*)

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A B S T R A C T

Grafting is the combination of different plant parts so that they unite and experience growth and development as one new plant after the tissue can regenerate. This research carried out a grafting experiment between jackfruit (Artocarpus heterophyllus) and durian (Durio zibethinus), two different types of fruit belonging to the same taxon class, namely dicotyledon. Even though these two plants belong to the same class, significant genetic differences and different environmental factors are the main challenges in efforts to combine them through grafting. The research results showed that no development occurred in the grafted plants. The factors for failure of grafting are genetic differences, environmental factors, and techniques in plant grafting.

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INTRODUCTION

Plants have extraordinary regeneration capacity because they are sessile organisms. Plants are able to repair damage caused by various biotic and abiotic threats. Plants can effectively heal wounds or damage by regenerating cut root tips and forming new organs and tissue when placed in a growth medium containing high levels of plant hormones. Two plants cut and put together is an example of the grafting process. Tissue and blood vessels regenerate around the cut site as the shoot (scion) and stock (rootstock) (Rahayu et al., 2021).

Grafting has become an important technique in agriculture to reproduce plant species that have superior characteristics and are mostly genetically heterogeneous. In recent years, various plants have been propagated by grafting to increase disease resistance, control fruit quality and increase harvest quantity (King et al., 2008).

In practice, grafting is mostly done by joining the stem of one plant (scion) to the stem system of another plant (stock). The formation of vascular tissue is necessary to establish the graft connection and graft viability. During the grafting process, the apoplasmic and symplasmic tissues are gradually rebuilt over days to weeks. Vascular formation occurs due to the process of cell division, cell differentiation and cell-cell adhesion, in the appropriate position. This happens in the grafting stem to regenerate and recombine each tissue (Ardana et al., 2022)

Jackfruit (*Artocarpus heterophyllus*) and durian (*Durio zibethinus*) are two types of fruit that are highly valued in the world of agriculture and Asian culinary culture. Jackfruit, with its sweet and aromatic flesh, and durian, known as the "king of fruits" with its unique taste and rich nutrition, both have a special place in society and the global market. Even though they have different characteristics, both have significant economic value and the potential to increase production.

Increasing the production and quality of these fruits has become a major focus in modern agricultural efforts. One approach used is the grafting technique, which allows grafting or combining parts of two different plants to create a hybrid plant with desired traits. Grafting has been successfully used to accelerate the development of new varieties, increase disease resistance, and increase fruit productivity (Triloba & Genotypes, 2020).

In this context, we conducted research on grafting between jackfruit and durian plants. These two types of plants have different growth characteristics, different growing challenges, and their advantages. By using grafting techniques, it is hoped that we can combine the superior properties of the two types of plants. The main aim of this research is to determine the success of grafting between different types of plants, namely jackfruit and durian.

THEORETICAL FRAMEWORK

Grafting is a vegetative propagation technique in which tissue from one species (stock) is combined with the scion (scion) of another species to form a new plant variety. Successful grafting involves combining vascular tissue (xylem and phloem) and non-vascular tissue (epidermis, cortex/pith) between the stock and scion. Basically, grafting is used so that the resulting plants have many varieties are of high quality, that are resistant to abiotic threats and disease (Vadde, 2022).

The basic technique in grafting consists of placing the cambium tissue of stock and scion plants so that the callus tissue produced from the stock and scion are interlocked to form a continuous living tissue. The cambium of stock plants and the cambium of scion plants respond to cutting by forming a mass of cells (callus tissue) that grows over the injured surface (cut site). The union resulting from the interlocking of callus tissue is the basis of grafting. Dicotyledonous plants have cambium; the cambium is a layer of cells that actively divide between the xylem (wood) and phloem tissue. Monocot plant stems do not have a continuous or thicker cambium layer, so grafting is rarely done on dicot plants (Crang et al., 2018).

Molecules exchanged between rootstock and scion, such as hormones, metabolites, proteins, and RNA, coordinate grafted plant parts and are thought to modulate healing (union) to facilitate regeneration of plant vascular tissue. Such a process results in successful grafted plants. But in many cases, there are some difficulties or disorders in carrying out grafting, which can appear in the early or late stages of plant growth, which is ultimately called 'grafting incompatibility'. One potential factor causing grafting incompatibility could be based on the lack of graft-transmissible RNA recognition to coordinate the stock-bud tissue response to development (Tedesco et al., 2022).

Different climates and ages of grafted plants also influence the success of grafting (germination time and percentage of grafting success) and the growth of grafting plants (length of shoots on the upper stem and number of new leaves (Nguyen & Yen, 2018). The next success factor is the grafting technique/method used. The grafting technique significantly affects the grafting of shoots, rootstock diameter, scion diameter, scion length, rootstock length, and number of leaves of grafted plants. Plants grafted using the gap grafting technique have the highest grafting success rate and maximum growth in plants (Beshir et al., 2019).

METHODS

This research was conducted for 28 days. The tools used in this research were scissors, knives, polybags, plastic, shovels and cameras. The materials used are durian plants, jackfruit, soil and water. This research procedure begins with preparing plant stock (rootstock) and scion plants (scion), along with the necessary equipment. In the next step, plant stock is selected with a similar size to the initial plant. Next, the lower plant stem is cut vertically, and a horizontal V-shaped incision is made.

On the other hand, the plant part is cut to a tapered shape to allow precise insertion into the plant stock space incision. The combination of these two plants is covered with plastic, starting from the bottom to the top. So that the grafted plant is protected from external factors that can interfere with growth, the plant is wrapped in plastic. Then, the grafted plants are placed in a shady place. During this period, the development and growth of grafted plants are carefully observed and documented. This process requires careful attention and accuracy to ensure successful grafting between jackfruit and durian plants.

RESULTS

Jackfruit (*Artocarpus heterophyllus*) and Durian (Durio sp.) are two types of plants that are very popular with Indonesian people. In this experiment, we carried out grafting between jackfruit plants and durian plants. The plant that is the stock is jackfruit, and the scion plant is durian. Plant grafting is shown in figure 1.

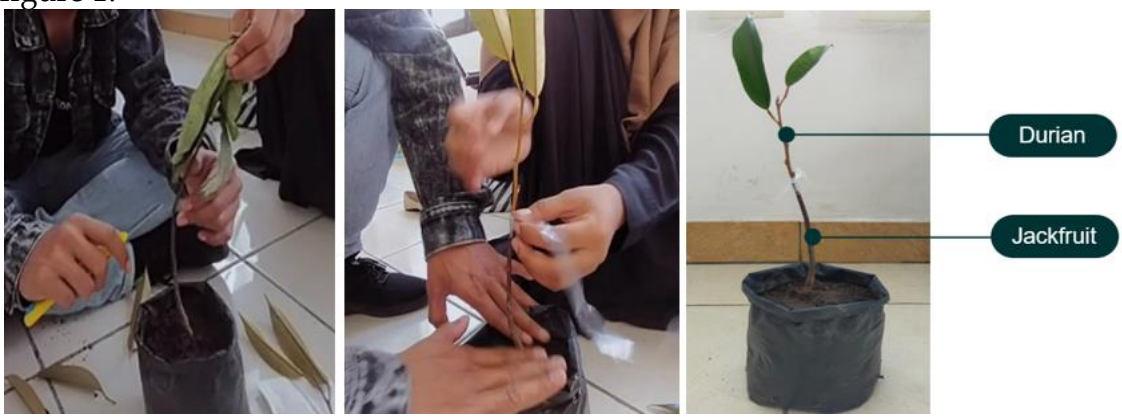

Figure 1. Grafting of Jackfruit and Durian Plants

The similarity in taxon level between durian and jackfruit plants is at the class level, namely the dicotyledon class. The degree of relationship between each of these grafting species is quite distant. Although both belong to the same class, they belong to different genera and families. The jackfruit plant, which has the scientific name *Artocarpus heterophyllus*, belongs to the Moraceae family, while the durian plant, with the scientific name *Durio zibethinus*, belongs to the Malvaceae family. This fairly distant degree of relationship shows the challenges that may arise in trying to combine these two types of plants through grafting. The results of growth and development of grafted plants are shown in Figure 2.

Day 1	Day 5	Day 8
		
Day 14	Day 21	Day 28

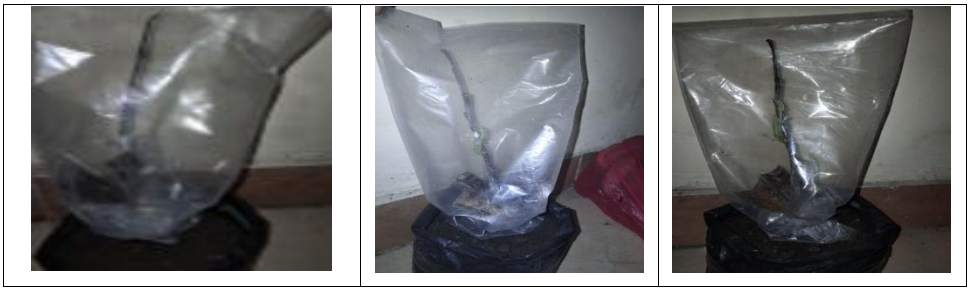

Figure 2. Development of grafted plants for 28 days

Based on Figure 2, on the 8th day, the leaves on the grafted plant fall. This aims to increase the strength of the scion plant in growing new shoots. On the 8th day, there was also new shoot growth on the lower stem. On the 11th day, there is growth and development of new shoots on the stems of the scion (durian). On the 12th day, the plant no longer has leaves, and new shoots develop on the lower stem. On the 13th day, new shoots from the lower stem are cut. This aims to focus growth and development on the scion (durian) plant. Furthermore, observations from day 14 to day 28 of the grafted plants showed no significant changes and appeared to be dead.

DISCUSSION

The main factor in graft failure between jackfruit and durian plants is significant genetic differences. As previously explained, jackfruit and durian have a fairly distant genetic relationship, even though they both belong to the dicotyledon class. These significant genetic differences can make it difficult for successful grafting, as the plants may have differences in tissue compatibility or response to the grafting process.

The plant grafting technique is a combination of two different plants involving a stock plant (scion) and a scion plant (rootstock). The scion plant is expected to have shoot development and growth and produce good-quality fruit. It is hoped that the rootstock will grow a strong root system that is able to adapt to poor soil conditions and pests. The grafted plants aim to have superior quality, especially a combination of positive traits found in stock plants and scion plants. Several factors influence plant grafting, namely the physiological characteristics of the plant, the health of the stock plant, the condition of the skin of the stock plant, the weather at the time the grafting is carried out, as well as technical factors including expertise in carrying out grafting techniques and grafting tools.

Based on the results of observations of grafted plants, it can be seen that the grafting carried out in this experiment has a low probability of success. Signs that the grafting has failed can be characterized by discoloration and leaf fall, brown stems, wilted plants, and rotting plant organs. This grafting failure can be caused by various factors such as poor grafting techniques, namely when the rootstock and scion tissues are not lined up correctly, improper plant grafting techniques, unstable weather conditions, an environment that is not sterile, the plant species being grafted is not suitable. Differences in

physiological characteristics between grafted plant species will inhibit the combination of stock stems with scion stems.

CONCLUSIONS AND RECOMMENDATIONS

This research highlights the complexity and challenges in grafting between jackfruit and durian plants, which have significant genetic differences. The research results confirm that the success of grafting between these two types of plants is low and requires more focused understanding and experimentation to overcome this problem. This research, while revealing obstacles, also opens up opportunities for continued research that could expand our understanding of plant breeding and potentially create hybrid plants valuable in the agricultural world.

FURTHER STUDY

With limited research on variables between plant species, namely jackfruit and durian, the researchers suggest that similar research be carried out targeting different generations, groups or different variables. Thus, the addition of mediating variables can also be studied by future researchers to gain new insight into the relationship between variables. To determine if any are significant. In addition, the results of this research can help future researchers identify what improvements can be made to be more sustainable and able to face changing preferences and needs. The above recommendations will help researchers to identify what factors have a significant influence on the purchasing behavior of different generations coming from different cultural backgrounds.

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