

Research Article

## Growth of morel berry (*Physalis angulata* L.) from different cutting types and plant growth regulators

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### ABSTRACT

Morel berries are generally propagated using seeds, and vegetative propagation could be an alternative for rapid propagation. This research aimed to evaluate morel berry seedlings from different cutting types and natural plant growth regulators. This research was carried out from May to October 2024 at Plant Laboratory 3, Politeknik Negeri Lampung, Lampung. The experiment was arranged in a randomized complete block design with two factors, i.e., cutting type and plant growth regulators. Observation variables included growth percentage, number of shoots, and shoot length. Data were analysed using analysis of variance (ANOVA) followed by the DMRT test at the 5% level. Based on data, there is no interaction between the first factor (cutting type) and the second factor (PGR). Vegetative propagating of the morel berry using shoot cuttings had a growth percentage of 81%. PGR from mungbean sprout extract had higher growth stimulation than other sources. A more in-depth study is needed regarding the appropriate concentration for each type of PGR.

**Keywords:** ciplukan; natural PGR; shoot cutting; stem cutting; vegetative propagation

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### INTRODUCTION

Morel berry (*Physalis angulata* L.), known as ciplukan (in Indonesian), is an herbaceous plant that is widely distributed throughout Indonesia (Fitri & Soegianto, 2024). It is a member of the Solanaceae family and native to Brazil, around the Amazon region (de Oliveira et al., 2020). Many researches on morel berry focus on biopharmaceutical aspects. Morel berries contain antioxidants, flavonoids, alkaloids, saponins, steroids, and tripernoids (Nuranda et al., 2016). This plant is known to be used as a natural abatement, anticancer, diabetes, antioxidant, and antibacterial (Nuranda et al., 2016; Ratri & Darini, 2016; Silalahi, 2018). Due to their high medicinal effect, the morel berries are prospective as a natural medicine in the future (Fadhli et al., 2023).

The demand for morel berries on the market is not only focused on their benefits as a medicinal plant but also as a fresh fruit. Morel berry fruit is sold at quite a high price. According to Salzabillah et al. (2022), morel berry farming has the potential for higher income and lower risk compared to tomatoes. The high diversity of *Physalis* spp. has great potential for crossbreeding and crop improvement (Sari et al., 2023). The high economic potential is not yet supported by appropriate cultivation techniques.

Adequate cultivation techniques can make morel berries a promising commodity (Singh et al., 2019), while morel berry cultivation in Indonesia has not been developed optimally. One of the important cultivation techniques is plant propagation. Morel berries are generally propagated generatively (Susanti et al., 2019), but some morel berry varieties require a relatively long time to produce seeds. Vegetative propagation is one solution to overcome this problem. Chaidir et al. (2015) have carried out vegetative plant propagation, namely, runduk cuttings (layering).

In plant propagation, especially vegetative propagation, growth regulators are needed to stimulate the formation of roots and shoots, such as IAA and IBA. Apart from that, several studies have initiated the use of natural PGRs such as shallots and bean sprouts extract that have been previously studied by Abdullah et al. (2019) and Jariah et al. (2022). In the study by Mariana et al. (2023), shallot extract increased the growth of the number of roots, number of shoots, number of leaves, and root length in coffee shoot cuttings. Shallots contain nicotinic acid, vitamin B1 (thiamin), riboflavin, rhizokalin, and the hormone auxin, which can accelerate plant growth, especially the roots. This allows minerals and nutrients in the soil to be optimally absorbed by the roots and distributed to all parts of the plant for growth (Agustin, 2021).

This research will evaluate several vegetative propagation methods as an effort to shorten the time needed to cultivate morel berry plants. The use of growth regulators made from natural ingredients, namely shallots, mungbean sprouts, and bamboo shoots, in this research, is so that farmers can make their own Plant Growth Regulator (PGR) independently and reduce chemical residues that can have a negative impact on the environment. Vegetative propagation is expected to be able to reduce the production costs of morel berry plants, and is an environmentally friendly agricultural alternative. This research aimed to observe the response of the morel berry under different cutting types and natural plant growth regulators.

## MATERIALS AND METHODS

This research was conducted from May to October 2024 at Plant Laboratory 3, Politeknik Negeri Lampung, Bandar Lampung. The experiment used polybags, morel berry seeds, Furadan, NPK fertilizer 16-16-16, manure, topsoil, shallots, mungbean sprouts, bamboo shoots, and detergent. Meanwhile, the tools in this research were pot trays, 50 % shade net, analytical scales, blenders, and sprayers.

This research was structured in a randomized complete block design (RCBD) consisting of two factors with three replications. The first factor was the method of plant propagation (B), which consisted of 2 levels: B1 (shoot cuttings) and B2 (stem cuttings). The second factor was the type of growth regulator (P), which consisted of 4 levels: P0= without PGR; P1= shallot extract; P2= sprout extract; P3= young bamboo shoot extract. Shoot cutting had an active tip growing point, while stem cutting had no tip growing point except auxiliary buds. Each treatment was repeated three times to obtain 24 experimental units. One experimental unit consisted of 3 plants and totaled 72 plants.

Cultivation techniques carried out on morel berry plants included: land preparation, seed sowing for mother plant, planting media preparation, planting, and plant maintenance, natural PGRs preparation, cuttings preparation, and cuttings maintenance (Figure 1).

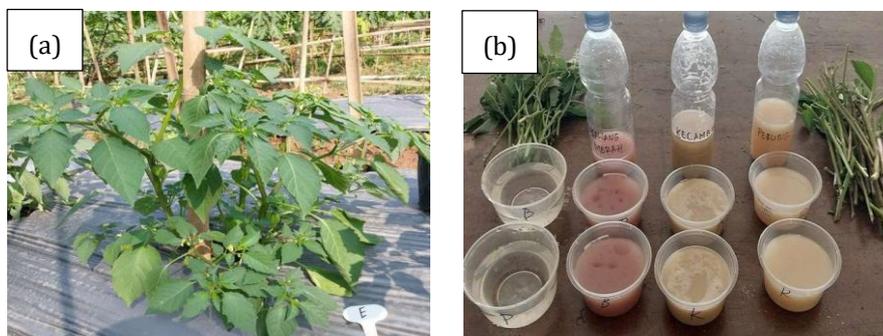


Figure 1. Preparation for propagating morel berry plants (a) The existing mother plant; (b) Preparation of various treatments

The planting material used for vegetative propagation was selected from local morel plants near the Lampung State Polytechnic, which were in the late vegetative to early generative phase. The mother plants were maintained in the experimental field. The

planting material was cut using pruning shears, leaving three nodes. Before planting, the planting material was soaked in a prepared plant growth regulator (PGR) solution for 15 min, then planted in the prepared growing medium.

Seeding was carried out for the process of forming seed sprouts from cutting, which grow into morel berry plant seedlings. The planting media used topsoil and cow manure with a ratio of 1:1. The planting medium was mixed evenly, then put into a polybag sized 20 x 20 cm. The polybags were then arranged with a distance of 30 cm.

The cutting was collected from the mother plant that had been grown, sized 10 cm of both shoot cuttings and stem cuttings. Length of cutting followed Cavusoglu & Kasim (2022) of *Physalis peruviana*. The cuttings were then soaked in prepared PGR for approximately 10 minutes according to the treatment. Then the planting medium was watered to field capacity. Watering was done once daily once, until the field capacity is reached. Weeding was done manually by pulling out the weeds by hand, once a week. Fertilization was done by applying basic fertilizer, namely 5 g of NPK per polybag.

*The procedure for making PGRs was as follows:*

1. Munbean sprout extract: mix 200 g of mungbean sprouts with 100 mL of distilled water, grind using a blender, then filter to get 200 mL of concentrate extract. This solution was determined as a stock solution with a concentration of 100%. For the concentration treatment, mungbean sprouts were used simply by diluting the solution according to Jariah et al. (2022).
2. Shallot extract was made from 1 kg of crushed shallot bulbs and filtered, and determined as a 100% solution according to Abdullah et al. (2019).
3. Bamboo shoot extract was made into stock first, by grinding 6 kg of bamboo shoots and then dissolving them in 10 L of water according to Sukmawati et al. (2021).

The observation referred to previous studies (Suwardi et al., 2023), including: percentage of growth (from planting to 1 month old), time of shoot emergence (days), the number of shoots (from planting to 1 month old), and length of shoots (from shoot appearance to 1 month old).

Data analysis used analysis of variance (ANOVA) at a 5% significance level. Then, Duncan's Multiple Range Tests (DMRT) was performed using 5% significance level for any significant differences.

## RESULTS AND DISCUSSION

There was an interaction between the variables number of shoots and shoot length, but there was no interaction between the variable age of shoots (Table 1). For the variable of sprouting age, there was an effect of cutting type and the source of PGR, but there was no interaction between treatments. The number of shoots was influenced by the application of growth regulators and the interaction between the two treatments, while the difference in planting material had no significant effect. The interaction between the cutting method and the planting material significantly affected the length of shoots in seedlings.

Table 1. Response of morel berry under different cutting types and plant growth regulator on sprouts age, number of shoots, and length of shoots

Treatments	Pr(>F)		
	Sprouts age	Number of shoots	Length of shoots
Cuttings types	0.0066**	0.6785 ns	0.3844 ns
PGR	0.0201*	0.0289*	0.0917 ns
Cuttings types x PGR	0.7294ns	0.0369*	0.0326*

Note: \*\* = highly significant; \* = significant; ns = not significant

The seedling establishment percentage was presented in Figure 2. The results obtained were that 81.11% of shoot cuttings successfully rooted and developed into plants, while stem cuttings were 61.11%. This is in line with Cavusoglu et al. (2019), where terminal cuttings (the tip) showed superiority in terms of marketable seedlings compared to subterminal (stem) cuttings. This finding concluded that shoot cutting was better as a propagation material than the stem. This is thought to be because the shoot part of the plant has younger tissue, so it is easier to undergo cell division and produce roots compared to the tissue found in the stem part. Cuttings of young stems or shoots also have tissue. There are a lot of better meristems and growth hormones, so that the roots and shoots come out faster compared to other types of cuttings.

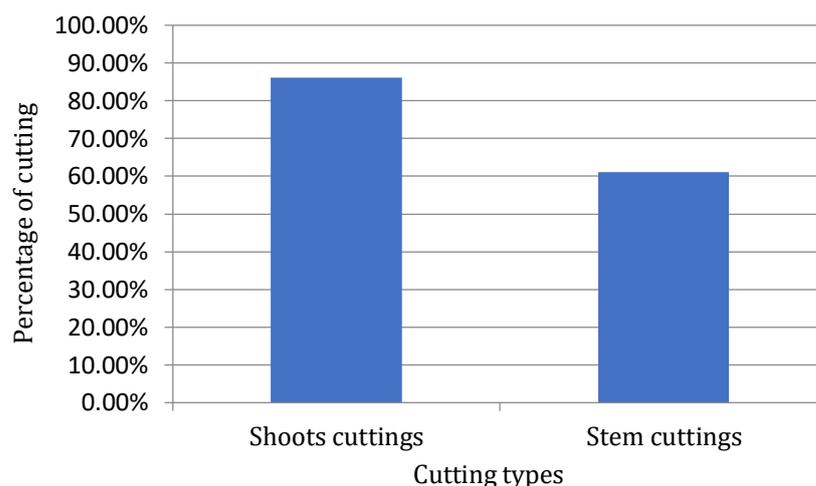


Figure 2. Percentage of cutting success based on differences in cutting material.

In the age variable for the emergence of shoots, there were differences in the results of the DMRT analysis, which were influenced by differences in cutting origin and PGR types (Table 2). Stem cuttings took a longer time to produce shoots than shoot cuttings. Natural PGR treatment extended the time of shoot emergence by 5-7 days. Table 2 shows that cutting without PGR treatments is significantly different in time of shoot emergence from those treated with bamboo shoot extract.

Table 2. The influence of the cutting type and PGR on the average age at which shoots emerge

Treatment	Shoots emergence (days)
Cuttings type	
Stem cutting	17.36a
Shoot cutting	9.37b
Type of PGR	
Without PGR	11.17b
Shallot extract	16.90ab
Mungbean sprouts extract	16.90ab
Bamboo shoot extract	18.57a

Note: Means followed by different letters are significantly different according to DMRT at  $p \leq 0.05$ .

The type of PGR treatments also influenced the number of shoots on the stem cutting material (Table 3). However, the effect of PGR was not significant on the shoot number and its length. It is likely that PGR treatment is less effective in stimulating shoot number and its length in shoot cuttings. Probably, the presence of apical dominance in shoot cutting suppresses shoot production and its elongation.

Table 3. Effect of different plant growth regulators on the shoot number and its length

Treatment	N	Number of shoots		Length of shoots (cm)	
		Stem cutting	Shoot cutting	Stem cutting	Shoot cutting
Without PGR	3	2.33b	4.00	2.33b	7.33
Shallot extract	3	2.33b	4.33	3.00b	4.66
Mungbean sprouts extract	3	11.00a	5.00	10.00a	5.33
Bamboo shoot extract	3	4.00b	8.33	2.33b	4.33

Note: Values in the same column followed by the same letter are not significantly different according to DMRT at  $p \leq 0.05$ .

The application of bean sprouts extract resulted in the highest number of shoots and the length of shoots (Table 3). This is thought to be caused by the fact that mungbean sprouts contain more shoot-stimulating substances (cytokinins). Mungbean sprout extract contains the auxin, which can influence the action of cytokinins. Based on research by Pamungkas and Nopiyanto (2020), the cytokinin contained in sprout extract reaches 96.26 ppm. This goes beyond the effect of shallot and bamboo shoot extracts in Kurniati et al. (2019) research on leaf growth in nutmeg seedlings. Cytokinin transport functions to initiate shoots, which will emerge when auxin is at the right concentration (Marlina et al., 2024). Mungbean sprouts contain macro and micronutrients, vitamins, sugars, and amino acids (Setiawati et al., 2018). One of the non-essential amino acids found in bean sprouts is tryptophan, which is known to act as a precursor for auxin biosynthesis. The auxin hormone functions to stimulate growth by stimulating cell division, chromosomal DNA synthesis, and stimulating plant root growth (Sinaga et al., 2013).

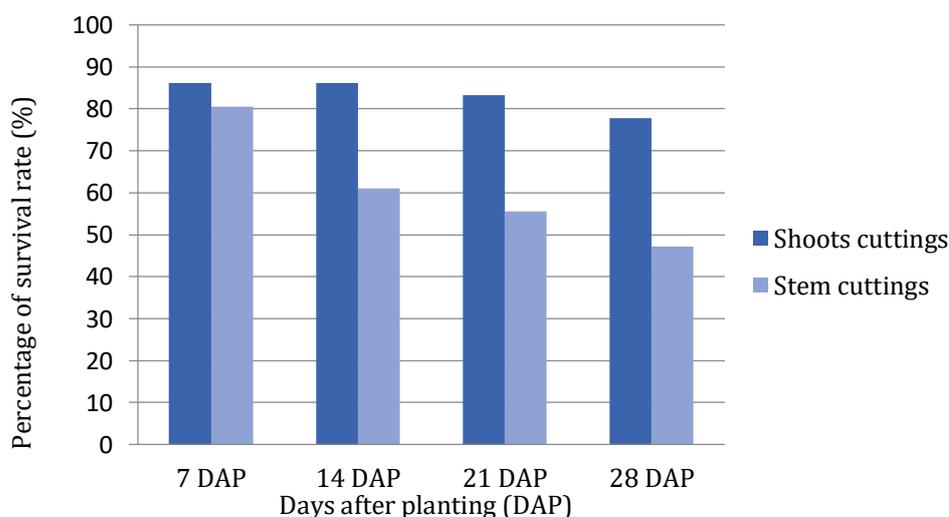


Figure 3. Effect of different cutting type on the survival rate (DAP = Days after planting)

The survival rate of seedlings propagated using plant shoots is higher than that of seedlings propagated through stem cuttings. From the first to the fourth week, both experienced a decline, but seedlings propagated by stem cuttings experienced a fairly sharp decline, namely from 80.5% to 47.2% in the fourth week (Figure 3). On the other hand, seedlings propagated using the shoot cutting method had a higher survival rate, namely 86.1% in the first week and 77.7% in the fourth week. According to Putri and Danu (2014), old cuttings are difficult to undergo dedifferentiation, which is the process of changing the structure and function of cells from stem or skin tissue to form adventitious roots. This is what makes the survival of seedlings originating from stem cutting propagation techniques unable to survive well.

## CONCLUSIONS

Morel berries could be propagated vegetatively. Shoot cutting produced a higher percentage of success rate than stem cutting. Natural PGR of mungbean sprout extract could stimulate the growth of morel berry cutting based on the number of shoots and the length of shoots. A more in-depth study is needed regarding the appropriate concentration for each type of PGR for better stimulation.

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