A Review: The Effect of Plant Growth Regulators on Micropropagation of *Aglaonema* sp.

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ABSTRACT

Nowadays, *Aglaonema* sp. becomes very famous in Indonesia. especially during the pandemic covid-19. Many people tend to stay home to stop the spreading of the virus. One of the activities can be done during staying home is growing the plants as well as ornamental plants. *Aglaonema* sp. is one of important and well-known foliage ornamental plants in Indonesia, commonly called as "Sri Rezeki". The generative or sexual reproduction of *Aglaonema* sp. is difficult and it contains some endogenous pathogen. The common propagation techniques are by cutting and seed which is risky in the spreading of the pathogen. Micropropagation is an advance technique to produce a large number of plants in a short time and pathogen-free transplant. This manuscript endeavour to include some important investigations and studies on the use of the Plant Growth Regulators (PGRs) on the *Aglaonema* sp. micropropagation

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1. INTRODUCTION

Some ornamental plants in the world have accompanied the historical value, used to use as an expression symbol of wellbeing and the beauty of landscape. As in Asia, Africa and Latin America using ornamental plants for the tradition of brighten ceremonies and national day celebrations, this condition increases the ornamental plants popularity. Currently, the most rapid expanding ornamental plants are foliage plants for indoor use, bedding and garden plants (Mariani et al., 2011). *Aglaonema* consists of many important and demanding cultivar of foliage plants due to their beautiful shape, colorful, drought tolerance and low relative humidity (Yeh et al., 2007).

Nowadays, *Aglaonema* sp. becomes very famous in Indonesia, especially during the pandemic covid-19. Many people tend to stay home to stop the spreading of the virus, one of the activities can be done during stay home is growing the plants as well as ornamental plants. *Aglaonema* sp. is one of important dan well known foliage ornamental plants in Indonesia, commonly called as "Sri Rezeki" and comprised more than 21 species (Dikayani et al., 2013). This genus also known as Chinese Evergreen, a monocot which is belongs to Araceae family and spreads around southeastern Asia, northeastern India, southern China, Indonesia, Malaysia, and New Guinea (Chen et al., 2003). This foliage ornamental plant has been produced

due to its attractive foliage shape, easy to cultivated, low light tolerance and low relative humidity (Henny, 2000; Chen et al., 2002). New cultivars have been released continuously to maintain the popularity of the plants (Chen et al., 2002).

Due to the non-simultaneous flowering and short life cycle of the pollen make the sexual reproduction difficult, so most of *Aglaonema* sp. have been propagated by cutting the rooting part from nodes or shoot basal division as the basic method (Barakat and Gaber, 2018). Another condition is the problem with endogenous pathogen that may stay in the vascular bundle tissue and may spread through the cutting method (Chase, 1997). Micropropagation is an advanced propagation method through vegetative way to produce large amount of seedling in a short time and pathogen-free transplants. This method starting with growing plantlets on a medium contains water and nutrition under aseptical condition (Chen, 2007; Chen et al., 2013; Chen 2015).

2. GENERAL INFORMATION

Aglaonema is a genus from monocots that belongs to Araceae family consists of 21 species that accepted and published (Table 1). These perennial herbs have an erect and decumbent stem which can grow along the ground and may rooting around the nodes. Containing the most

beautiful shape and colors of the leaves, it shows very good colors combination, such as green and orange, green and red, green and yellow, green and white, green and pink, etc (Mariani et al., 2011). Most of *Aglaonema*'s species have white roots, 1-5 cm thick stem, can reach until 50 cm in height, the inflorescence type called a spadix (Mariani et al., 2011), the color of the flower mostly white and normally bloom during March-July. *Aglaonema* also contains come toxic agent named calcium oxalate crystal to protect themselves from the enemy, this agent will cause some irritation on the skin.

Scientific classification

Kingdom	: <i>Plantae</i>
Subkingdom	: <i>Tracheobionta</i>
Superdivision	: <i>Spermathophyta</i>
Division	: <i>Magnoliophyta</i>
Class	: <i>Liliopsida</i>
Ordo	: <i>Alismatales</i>
Family	: <i>Araceae</i>
Genus	: <i>Aglaonema</i>
Species	: <i>Aglaonema</i> sp.

Table 1. Accepted species from *Araceae* family (Govaerts et al., 2002)

No	Spesies	Origin	Leaves color combination
1	<i>Aglaonema brevispathum</i>	Indochina	Light-dark green
2	<i>Aglaonema chermisiriwattanae</i>	Thailand	Greenish white
3	<i>Aglaonema cochinchinense</i>	Vietnam, Cambodia, Thailand, and Malaysia	Green -white
4	<i>Aglaonema commutatum</i>	Philippines and Indonesia	Green-white
5	<i>Aglaonema cordifolium</i>	Mindanao, Philippines	Green
6	<i>Aglaonema costatum</i>	Malaysia and Indochina	Green-white
7	<i>Aglaonema densinervium</i>	Philippines and Indonesia	Green
8	<i>Aglaonema flemingianum</i>	Terengganu	Dark green
9	<i>Aglaonema hookerianum</i>	Bangladesh and Myanmar	Green-light yellow
10	<i>Aglaonema marantifolium</i>	Indonesia and New Guinea	Green-white
11	<i>Aglaonema modestum</i>	Japan, Bangladesh, Indochina, Southern-china	Green-white
12	<i>Aglaonema nebulosum</i>	Malaysia and Indonesia	Green-white
13	<i>Aglaonema nitidum</i>	Malaysia, Indonesia and Indochina	Green-grey
14	<i>Aglaonema ovatum</i>	Laos, Thailand, Vietnam	Green
15	<i>Aglaonema philippinense</i>	Philippines and Indonesia	Greenish white
16	<i>Aglaonema pictum</i>	Indonesia	Dark green-light green-white
17	<i>Aglaonema pumilum</i>	Myanmar and Thailand	Dark green-white
18	<i>Aglaonema roebelini</i>	Philippines	Green-white
19	<i>Aglaonema rotundum</i>	Indonesia	Dark purple-green and dark purple-red
20	<i>Aglaonema tricolor</i>	Philippines	Pink-green-white
21	<i>Aglaonema vittatum</i>	Indonesia	Green-white

3. MICROPROPAGATION OF *Aglaonema* sp.

Micropropagation is the tissue culture technique application to propagate plants under aseptical condition. This technique could be done to produce large amount of pathogen-free and uniform transplants in a short time and in a small place (Chen et al., 2013; Chen 2015). Some protocols have been conducted for the micropropagation of *Aglaonema* sp., but still not meet the purposes with *Aglaonema*, mainly due to the difficulty to maintain the aseptical culture condition (Chen and Yeh, 2007), low rate of shoot multiplication reported by Chen and Yeh (2007) as well as in the research conducted by Zhang et al.

(2004), and lack of technical information on micropropagation procedure of *Aglaonema* (Mariani et al., 2011).

In vitro technique could be done for physiologically uniform of plant production and rapid multiplication. In many micropropagation's research conducted with high number of treatments, using the plant growth regulators (PGRs) and some dosages were tested to obtain a good propagation protocol. Endogenous microbial contamination is the most serious problem in micropropagation of ornamental aroids, including *Aglaonema* (Chen and Yeh, 2007).

The use of PGR combination on the medium for *Aglaonema* sp. micropropagation was conducted by many researchers for some purposes. Fang et al. (2013) conducted a research with *Aglaonema* 'Lady valentine' as the popular red cultivar that were cultured on the Murashige and Skoog (MS) medium supplemented with PGRs to develop an efficient micropropagation procedure through adventitious shoot induction and proliferation. The single nodal stem with an axillary bud were cultured on 10 ml MS medium supplemented with 32 mg. l⁻¹ gentamicin, 8 mg. l⁻¹ tetracycline and 4 mg. l⁻¹ chloramphenicol. The best growth of axillary obtained when 10 mg. l⁻¹ of 6-benzyladenine (BA) supplemented to

the medium. Afterwards, the single nodal stem produced were cultured on MS medium supplemented with PGR combination; naphthalene acetic acid (NAA) and thidiazuron (TDZ) (Table 2). The results showed that the average of 10.9 adventitious shoots per stem obtained from the combination of 0.5 mg. l⁻¹ NAA and 2 mg. l⁻¹ TDZ. Later on, small shoots formation was culture on the medium supplemented with BA and GA₃. The concentration of 0.5-5 mg. l⁻¹ of BA showed more effective for shoot proliferation and elongation compared to 0.5 mg. l⁻¹ GA₃ treatments (Fang et al., 2013). After three months of culture, the longest shoot (2.69 cm) were obtained from 5 mg. l⁻¹ BA.

Table 2. The effect of NAA and TDZ combination on the adventitious shoot induction performance in *Aglaonema* "Lady Valentine" stem nodal segments after three months culture (Fang et al., 2013)

No	PGR (mg. l ⁻¹)		% Adventitious shoot induction	Number of adventitious shoots induced
	NAA	TDZ		
1	1	0	16.1±6.1 ^b	0.2±0.0 ^c
2	0.1	0.5	88.9±11.1 ^a	4.5±0.9 ^{bc}
3	0.1	1	68.6±11.5 ^a	8.9±2.0 ^{ab}
4	0.25	0.5	25.0±8.4 ^b	0.3±0.1 ^c
5	0.25	1	25.0±8.4 ^b	0.7±0.5 ^c
6	0.25	2	80.2±8.8 ^a	9.8±1.5 ^a
7	0.5	1	63.9±13.9 ^a	7.0±1.2 ^{ab}
8	0.5	2	61.1±10.4 ^a	10.9±2.5 ^a
9	1	2	59.0±3.5 ^a	9.0±1.8 ^{ab}

The research conducted with *Aglaonema* 'White Tip' cultivar showed that each nodal formed six shoots after cultured on MS medium supplemented with 6.8 mg. l⁻¹ BA after 60 days of culture (Chen and Yeh, 2007). Direct shoot formation induced on *Aglaonema* 'White Tip' after the explants cultured on the medium supplemented with 1.1-2.2 mg. l⁻¹ dicamba (3,6-dichloro-2-methoxybenzoic acid) and 2.2 mg. l⁻¹ TDZ (Yeh, 2007). While in *Aglaonema commutatum*, an average of 4.1 shoots formed every month from the stem which were cultured on the medium supplemented with 2.5 mg. l⁻¹ BA and 0.05-0.1 mg. l⁻¹ NAA (Zhang et al., 2004). *Aglaonema* var. Lipstick research showed that after 16 weeks of culture formed callus formation by combination treatment of 5 mg. l⁻¹ IAA and 5 mg. l⁻¹ BAP as well as in the combination of 8 mg. l⁻¹ IAA and 5 mg. l⁻¹ BAP, the color of the callus are clear, globular shape and friable textures (Dewi et al., 2012).

Aglaonema widuri or *Aglaonema* red peacock were micropropagated on MS medium supplemented with three cytokinin (BA, TDZ and 2-ip) with one auxin (NAA) aimed to develop a protocol for high frequency multiplication (Fig.1). The highest shoot proliferation rate obtained in the combination of 3 mg. l⁻¹ BA and 0.2 mg. l⁻¹ NAA (6.00 number of shoots and 7.75 cm in length/explant), the maximum nodes formed by the combination of 4.00 mg. l⁻¹ BA + 0.10 mg. l⁻¹ NAA 0.50 mg. l⁻¹ TDZ (13.25/explant), The largest leaf number formed in the combination of 3.50 mg. l⁻¹ BA and 0.20 mg. l⁻¹ NAA, while the maximum root development obtained from the combination of 3.00 mg. l⁻¹ and 0.20 mg. l⁻¹ NAA. The most suitable plant growth regulators for *Aglaonema widuri* tissue culture was the combination of 3.50 mg. l⁻¹ BA and 0.20 mg. l⁻¹ NAA (Kaviani et al., 2018).

Figure 1. The effect of PGRs on the proliferation and elongation of *Aglaonema widuri*: A. Mother plants growing in the greenhouse, B. Shoot tips cultivated on the medium containing PGRs, C,D,E and F. Development of the explants, G. Shoot proliferation, leaf induction and growth, H. Plantlets with shoots and roots proliferation after three months of culture (Kaviani et al., 2018).

4. CONCLUSION

Aglaonema is monocots that's belonging to the Araceae family and consist of around 21 species. The popularity of this genus is attributed by their beautiful shape and color of the leave, easy to grow, low light tolerance and low humidity. The rooting of cutting of basal shoots are the main method of cultivating the *Aglaonema* sp., this method is high risk of pathogen transfer since the endogenous pathogen as the main problem from this genus. Some micropropagation techniques were conducted to cultivated the *Aglaonema* sp. in a short time, with a large number of seedlings in a small place and to produce plant-free pathogen, the use of the PGRs combination is one of the methods in micropropagation. Further research needed to complete the protocols of the *Aglaonema* sp. micropropagation.

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