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Plant Growth of Eggplant (*Solanum melongena* L.) In Vitro in Drought Stress Polyethylene Glycol (PEG)

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ABSTRAK

Cekaman kekeringan merupakan salah satu isu penting terkait dengan efek pemanasan global yang menuntut untuk dikembangkannya komoditas pertanian yang toleran kekeringan. Terung merupakan salah satu komoditas pertanian hortikultura yang berpotensi untuk dikembangkan di lahan kering sehingga perlu dilakukannya studi terkait respon pertumbuhan tanaman terung tercekam kekeringan. Penelitian ini bertujuan untuk melihat pertumbuhan tanaman terung *in vitro* pada kondisi tercekam kekeringan PEG. Penelitian ini dilaksanakan di laboratorium Kultur Jaringan, Departemen Agronomi dan Hortikultura, Institut Pertanian Bogor. Penelitian ini disusun dalam rancangan acak lengkap satu faktor yaitu berupa aksesi terung. Hasil penelitian menunjukkan bahwa PEG pada media *in vitro* memberikan pengaruh nyata dan sangat nyata pada persentase hidup eksplan, pertambahan tinggi tunas, dan jumlah daun tanaman terung. Eksplan tanaman terung membentuk kalus sebagai salah satu upaya penghindaran dari kondisi tercekam kekeringan.

Kata kunci: kekurangan air, kultur jaringan, solanaceae, toleran

ABSTRACT

Drought stress is one of the important issues related to the global warming that demand for the development of drought tolerant crops. Eggplant is one of the agricultural commodities which can be developed in dry land so plant growth of eggplant need to be learned. The objectives of this study were to study the effect of several concentrations of polyethylene glycol (PEG) on the in vitro growth of eggplant, and to find the drought tolerant eggplant accessions in dry land. The experiment was conducted at the Laboratory of Tissue Culture, Department of Agronomy and Horticulture, Bogor Agricultural University. The experiment was laid on a completely randomized design with one factor. The factor was eggplant accessions. The results showed that PEG in vitro media significantly affected the survival percentage, the percentage of callus, developed the bud and the number of leaves of eggplant. Callus in eggplant explants as a way of avoiding drought stress.

Keywords: solanaceae, tissue culture, tolerant, water deficiency

INTRODUCTION

Eggplant (*Solanum melongena* L.) is one of the original vegetable plants tropics that quite popular in Indonesia and easily found in traditional markets with relatively cheap price. Eggplant contains vitamins A, B1, B2, C, P and phosphorus as well as having the benefits of traditional medicine as a drug itching of the skin, toothache, hemorrhoids and high blood pressure (Hastuti, 2007). Prospects for the development of vegetable commodities in Indonesia is profitable because it has a high economic value and potential of the market wide open, both domestically and abroad (Zulkarnain, 2010). Increased public welfare and awareness of healthy living resulted in increased consumption of vegetables including eggplant. Data consumption of calories (kcal) per capita per day of vegetables in March 2013 by 34.96 and rose to 36.71 in September 2013 (SUSENAS BPS 2014).

Drought stress is one of the main problems of agricultural lands nowadays. Global warming resulting in erratic climate change and the decreasing availability of groundwater as a result of competition the use of ground water for industrial needs (Efendi *et al*. 2010). This makes the crop land is not always ideal for plant growth so that the development of drought-tolerant type of eggplant that needs to be done in order to improve national eggplant production. Agricultural extension program at this time was only possible with the opening of the area is generally marginal (sub-optimal), such as the dry land with drought stress constraints.

One of the early stages of the development process of the drought that gripped the eggplant plants through observation of plant growth of eggplant gripped by drought in vitro. Using PEG media in vitro is a fast and efficient alternative to study the process of plant growth of eggplant drought tolerant. The compound polyethylene glycol (PEG) is a compound that can reduce osmotic potential through the activity of matrix sub-units of ethylene oxide that is able to bind water molecules by hydrogen bonds. The use of PEG 6000 solution with a concentration of 5-20% in the in vitro media is expected to create an osmotic potential that is equivalent to the condition of soil moisture field capacity and the critical point so the explants gave the same response in plants that experienced stress in the field (Rahayu et al. 2005). This research aims to study the growth of eggplant seized PEG in vitro.

MATERIALS AND METHODS

This research was conducted at Tissue Culture Laboratory, Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor Agricultural University in January-July 2014. Plant material of research used sixteen accessions eggplant. Sixteen accessions eggplant were derived from eggplant of farmers in agricultural land area tends to dry.

The plant material used in this study is the plant material in the form of seeds sixteen accessions eggplant (Kania F1, 001, 007, 013, 016, 030, 034, 035, 055, 057, 069, 071, 072, 078, 085, and 090). Material of culture media Murashige and Skoog (MS) is used as a cover in order compactor, distilled water, sugar, filter paper, and foam. The chemicals used include alcohol and 96% commercial bleach materials containing sodium hypochlorite, KOH 1 N as an acidity regulator media solution, and polyethylene glycols (PEG) 6000.

This research is compiled according to a completely randomized design (CRD) with one factor. Factors in this research that a number of eggplant (F1 Kania, 001, 007, 013, 016, 030, 034, 035, 055, 057, 069, 071, 072, 078, 085, and 090). Media PEG used is media MS0 + PEG 10% is equivalent to the osmotic pressure of -0.19 MPa (Mexal et al. 1975) is a medium eggplant drought selection in vitro (Sinaga, 2015). The addition of PEG in the media causes the media will become liquid so as to prevent the explants did not sink then used foam and filter paper. The explants were used in the media treatment of PEG in the form of cutting the buds with a size of 0.5 cm were obtained from the results of the subculture plantlets eggplant plants. The explants were planted on top of the foam that has been riddled with a diameter of 2 mm at the media treatment in the form of liquid media.

Experimental unit consisted of one bottle culture explants be planted four cuttings of bud plant eggplant. Each treatment was replicated three times. Total culture bottles were 48 bottles with a total of 192 explants. Data were analyzed using ANOVA and significant data were analyzed further test DMRT.

RESULT AND DISCUSSION

Seed Germination and Plant Eggplant Subculture In Vitro

Eggplant crop seed germination process in vitro activity sterilization process begins with the seeds of eggplant. Sterile seeds that have germinated in MS0 media for 14 days. Each eggplant seeds have different growth rates varied. At one bottle culture, there are three types of types of sprouts that arise. The first type; seeds grow perfectly that consists of root, hypocotyl, and epicotyl (3 leaves open), the second type; seeds have a root, hypocotyl, and epicotyl (leaf bud), a third type; the new seeds bring candidates hypocotyl (it still takes time for the process of germination). Plant sprouts eggplant type 2 and 3 continued to grow well, but it took about a week to be perfect and ready to sprout in the subculture.

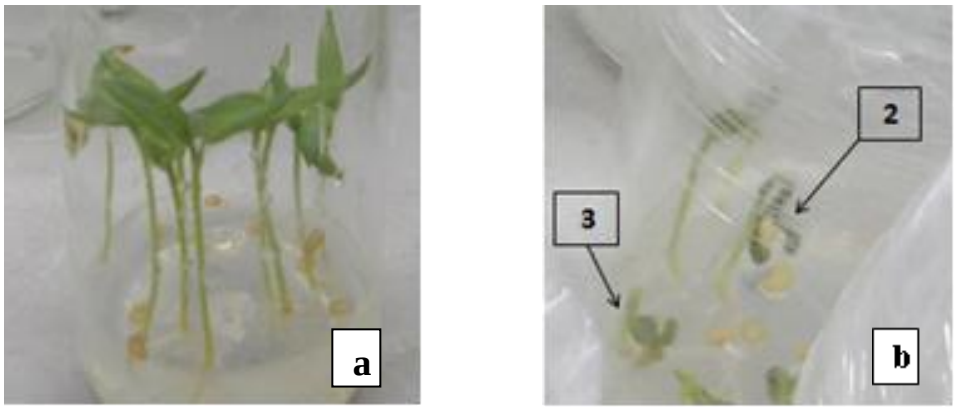

Fig 1. Shoot of Eggplant In Vitro
a. Shoot of Eggplant Type 1
b. Shoot of Eggplant Type 2 and 3

Fig 2. Plantlet Eggplant Subculture

Eggplant plants grow well during the two weeks of germination (Figure 1). After two weeks, epicotyl plant is cut and planted in the media subculture MS0 (Figure 2). At the beginning of subculture, epicotyl eggplant plants start to form callus on the wound that is embedded in the media, and then differentiate into the roots of the first week, then started having as height, number of shoots, and the number of leaves on the second week until the fourth week. Subculture eggplant plants grow well for two weeks until the eyes tunas- buds to be used as explants in media PEG.

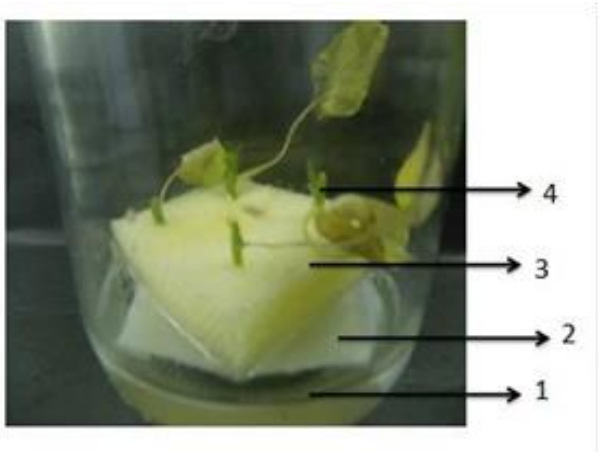

Figure 3 Media MS0 treatment in the form of liquid PEG.
1. Liquid Media MS0, 2. Paper filter 3. Foam, 4. Eksplan cuttings on buds.

Conditions of explants in the first week still looks fresh (Figure 3). Explants condition began to be seen to experience the difference at 2 and 3 week after treatments (WAT). On 3 WAT, largely seen explants remained green but shoots stunted growth and produce bit leaves. The percentage explants live of 16 accessions of eggplant have significantly different results on 2 and 3 WAT while the percentage explants callus, shoots as height and number of leaves were not significantly different (Table 1). This suggests that the growth of 16 accessions of eggplant explants had not much different response to stress PEG.

Callus formed on media PEG looked brown. Hartanti *et al*. (2011) suggest that the tobacco plant explants formed callus on medium without PEG was greenish white with compact texture. The white color indicates that the presence of callus leucoplast was grains colorless plastids and starch. The white color turns white or green greenish discoloration which occurred as a result of the cell begins to form chlorophyll. Robbiani (2010) explains that the brown callus which is a response to the oxidation of the phenolic compounds due to the wounding of a tissue explants. Callus formation on explant eggplant plants showed that callus is one of the positive response of the explants to survive in conditions of drought gripped.

Response Eggplant Plant Growth In Vitro

The percentage explants live seen from the color of the explants. Green explants were plants which still alive while the brown explants were plants which already dead. The percentage of explants callus were forming callus explants in the tissue explants were planted while the shoots observed on the explants are axillar derived from cuttings bud explants. Added shoot height is measured from the bottle without removing the explants.

Table 1 Percentage of explants live, the percentage of explants callus, shoots as height and number of leaves 16 accessions of eggplant explants at 1-3 WAT

WAT	Percentage Explants Live	Percentage Explants Callus	Shoots as Height	Number of Leaves
1	100.00a	10.94b	0.06c	0.08c
2	94.82a	25.00a	0.04c	0.31c
3	89.58a	27.08b	0.02c	0.48c

WA= Week After Treatment ; Values followed by the same letter in the same column shows the results are not significantly different at 5% DMRT

Based on DMRT (Table 1), the percentage explants live, shoots as height and number of leaves was not significantly different in explants for 3 WAT while the percentage explants callus on 2 and 3 WAT were not significantly different. It showed that explants eggplant plants able to survive in the media seized with PEG. Explants callus observed to see the ability of callus and development of explants callus on media PEG which showed a significant increase in the explant callus on the plant eggplant.

Shoot formation is defined as the formation of the leaves where the proliferation greatly affects plant growth and development. According to George (2008), the formation of buds in vitro culture more often than was first induced root formation mechanism of photosynthesis that lasted more optimal culture. The higher the concentration of PEG given to the media then the increase in the lower high-bud explants.

The addition of PEG in vitro media real negative effect on the growth of shoots explant peanuts. PEG treatment significantly reduced the increase of shoot height and number of leaves (Rahayu *et al*., 2005). According to Kong *et al*. (1998) PEG in the media could reduce proliferation and tissue growth and regeneration bud explants. Osmotic potential growth media were important factors that affect the proliferation of shoots. On the results of the study, although the number of leaves increased but not different in any WAT. Byari and Al-Rabighi (1995) stated that the drought caused a decline in the number of leaves significantly in plant eggplant. Drought also lowers the dry weight of leaves, stems and roots of the plant eggplant.

Table 2 The percentage of explants live of sixteen accessions eggplant explants on media PEG

Eggplant Accessions	Percentage Explants Live
Kania F1	100.00 [a]
001	83.33 [a]
007	100.00 [a]
013	75.00 [ab]
016	100.00 [a]
030	50.00 [b]
034	75.00 [ab]
035	91.67 [a]
055	91.67 [a]
057	83.33 [a]
069	83.33 [a]
071	100.00 [a]
072	100.00 [a]
078	100.00 [a]
085	100.00 [a]
090	100.00 [a]

Values followed by the same letter in the same column shows the results are not significantly different at 5% DMRT

Provision of PEG to decreased the water potential of media is expected to function as selective conditions for the suspect tissue responses were planted to drought stress and isolate the cells / tissues variants that have a stress tolerant phenotype. Effectiveness of PEG to presume eggplant plant responses to drought stress in vitro was tested by evaluating the survivability of the sixteenth number eggplant to drought stress.

Eggplant plants can grow well in drought conditions compared to other vegetable crops. Although eggplant is known more tolerant to drought compared with other vegetable crops, eggplant plants have diverse levels of drought tolerance. At some level of drought stress, the process of photosynthesis maintained better by plants eggplant than other vegetable crops (Sudarmonowati *et al*. 2012). Leaf relative water content (RWC) eggplant crop is higher than the average value of C3 plants recorded by Ludlow (1976), thus indicating that the eggplant plants can adapt well in conditions of drought stress.

CONCLUSION

The addition of PEG to the media in vitro decreased the percentage explants live, shoot as height and number of leaves of eggplant. Eggplant explants formed callus as one of the efforts avoidance of drought stress.

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