The use of polyethylene glycol as simulating media of drought stress on viability of seeds varieties of Cacao (*Theobroma Cacao* L.) on germination stadia

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Abstract. This study was aimed at determining cacao varieties that are tolerant to drought stress and assessing the effectiveness of the use of PEG 6000 as a media simulation to drought stress. Experiment was arranged in a Completely Randomized Design (CRD) non-factorial, replication four times. PEG concentration, consisted of 4 levels, namely control, 15%, 20%, and 25%. PEG concentration on 25% exerted significant effects on viability for twelve days. While PEG concentration on 20% and 15%.

1. Introduction
Cocoa is a plantation commodity that most of the management is carried out by the people so that it contributes to the economy based on rural communities. Cocoa also contributes greatly to the acquisition of foreign exchange. In an effort to support a program to increase cocoa production, the role of seed is very strategic because cocoa agribusiness requires quality seeds that meet the right five types, quality, time, amount and price.

According to the cocoa plantation statistic [1] at present, the area of the crop, cocoa production, and productivity in North Sumatra province each year has decreased in 2015, the planted area of 63.6 thousand hectares, cocoa production of 30,600 tons and cocoa productivity amounting to 763 kg/ha. Whereas in 2016 it was 57.3 thousand hectares, cocoa crop production was 15,161 tons and cocoa productivity was 705 kg/ha.

The cause of the low productivity of crops is that most cocoa plantations have not used superior planting material, planting has been old, the cultivation technology has not been applied well, and the attack of pests and plant diseases. In addition, environmental stress is the biggest threat to agricultural and plantation businesses where water stress or drought stress is the highest cause of low crop production.

For this reason, it is necessary to know the response of cocoa to drought stress, both at the level of germination using PEG 6000 compounds.

2. Materials and Methods
Research on screening of growth barriers using PEG (Poly Ethylene Glycol) 6000 solution in the laboratory. The materials used in this study were: cocoa beans clone TSH 858 obtained from palm oil
research centre, chemical compound PEG 6000, and aquadest. The tools used include petridish, filter paper, drop pipettes, and measuring cups.

For observation and measurement of germination, each time a cocoa clone is germinated on filter paper media and put into Petridis which has been given the name PEG in accordance with the predetermined change. In each Petridis 5 (five) cocoa beans were added.

2.1. Data analysis
Drought tolerance testing with PEG 6000 solution his study uses a Completely Randomized Design (CRD) 4 (four) replications with treatment non-factorial, each combination of treatment contained 5 (five) cocoa beans.

3. Results and Discussion
Viability of cocoa beans Germination was observed by calculating the percentage of seeds germinating from the total germination. Observation of germination of seeds is carried out every day until the 12th day.

| Treatment        | Mean of square | Viability of day 4th | Viability of day 6th | Viability of day 10th | Viability of day 12th |
|------------------|----------------|----------------------|----------------------|-----------------------|-----------------------|
| P0 (control)     | 5.00           | 5.00                 | 5.00                 | 4.00                  |
| P1 (solution 15%)| 5.00           | 4.75                 | 4.00                 | 1.75                  |
| P2 (solution 20%)| 5.00           | 4.25                 | 4.00                 | 0.75                  |
| P3 (solution 25%)| 4.00           | 3.75                 | 1.75                 | 0.25                  |

Data presented in Table 1 shows that application of PEG affected significantly increased viability of day four, day nine, day ten, and day twelve for application PEG of concentration P3 is 25%. From the results of the 5% DMRT test, it can be seen that the average of viability decreases with increasing levels of PEG solution.

At a level of 15% PEG solution, the rate of decline in sprouting power has begun showed significant differences in control (0% / without PEG solution). However, the decrease in germination at 15% PEG solution very small that is only about 10%.

![Figure 1. The viability of Cacao seed](image-url)
Seed germination in PEG solution as an osmotic solution is an indirect filtering method for resistance to drought stress because the osmotic pressure of the solution is much higher than the osmotic pressure of pure water. The more PEG volume dissolved, the higher the osmotic pressure of the solution formed. In such circumstances, there will be a bottleneck in the process of imbuing water into the seeds when germinated using the osmotic solution. The more able a seed is varieties facing high osmotic stress means more resistance to drought stress [2]

Seed cells have a certain osmotic value, as is the case with PEG solutions. By making various concentrations of PEG can be known the same concentration or almost the same as the osmotic value of cocoa seeds (isotonic); so as to prevent the process of going out or entering water into the seeds. In other words, the imbalance process, which is the main requirement for the occurrence of seed germination does not occur. For the time being the parameters used as an indication that the osmotic value of PEG solution is equal to the osmotic value of cocoa seeds is that the roots do not come out during the germination process [3].

4. Conclusions
Filtering the resistance of cocoa genotypes to drought stress on level of germination, preferably using levels of PEG solution on concentration of 20% (weight/volume).

References
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