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Seed vigor testing of coffee [*Coffea sp.*] to gibberellin hormone [GA_3] concentration and water temperature differences

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Abstract. West Sumatra is one producing coffee region in Indonesia that contributes to the economy in Indonesia because unstable need expand. Optimizing generative propagation of coffee plants with gibberellin hormone treatment and different water temperatures on coffee seed germination stage. The research was conducted at the Seed Technology Laboratory Faculty Agriculture, Andalas University from July to September 2020. Research methods used randomized block design [RBD] with 2 treatments namely concentration hormone gibberellin and immersion water temperature differences. Measurement parameters are maximum growth potential [%], First Count Test [FCT] [%], and Index Value Test [IVT] [days]. All parameter observation results showed a significant effect on the treatment of gibberellin hormone concentration and water temperature treatment. G4S1 sample [the combination of 200 ppm gibberellin hormone concentration and room water temperature treatments] has resulted as the best treatment for all parameters. Respectively, 0.79 days for index value test, 76.67% for the first count test, and 85% for the maximum growth potential parameters.

Keywords: Index Value Test, First Count Test, Room Water Temperature

1. Introduction

The Productivity of the coffee plant is hampered due to several factors, namely abnormal seeds, double branching, and undeveloped roots, in this case, maintenance such as the use of inappropriate planting media, poor light intensity, and ineffective planting of seeds cause the growth coffee seeds to be disrupted of Netsere and Kufa [9]. The Problem with the generative propagation of coffee is that coffee beans take a long time to germinate. The condition of the hard seed coat has an impact on the water and air needed in the germination process so that it cannot enter to germinate and takes a long time of Lestari et al [6].

Impermeable seed coat also has the effect of reducing the O_2 content in the seeds so that in anaerobic conditions there is a synthesis of growth inhibitors. This situation will certainly have an impact on the provision of seeds of Najiati and Danarti [8]. Slow and nonuniform seed growth has resulted in poor seed vigor processes of Rosa et al [11].

Gibberellin will play a role in the germination phase of the formation of the α-amylase enzyme in the aleurone layer, which affects the extension of the plant segments by increasing the number and

size of cells in these segments of Andjarikmawati et al[1]. This is based on research that can optimize the percentage and speed of germination of mangosteen and passion fruit seeds by immersing 50 ppm of gibberellin of Hardiyanto [5].

One method used to break seed dormancy is to soak the seeds in hot water. Soaking the seeds at different times is to see the effective soaking time in overcoming dormancy. Medium-term storage of coffee seeds has meant that the seeds can be stored for 10 months at 15 ° C at 10 - 11% moisture content of Rosa et al [11].

2. Materials and Methods

2.1 Place and Time

This research was conducted at the Laboratory of Seed Technology, Faculty of Agriculture, Andalas University time from July until September 2020.

2.2 Materials and Tools

The research used materials such as robusta coffee seeds taken in the Solok area, sterile sand, gibberellin hormone, 96% alcohol, Aquadest, Tissue, HVS paper, and label paper. The tools used in this study were seed bags, hand sprayers, plastic bottles, analytical scales, beaker glass, ovens, thermometers, cameras, stoves, and stationery.

2.3 Research Methods

This study used a randomized block design [RBD] with 2 treatment factors, namely:

Factor I: Concentration of the hormone gibberellin [GA_3] [G] which consists 3 levels, namely:

G1: 50 ppm
G2: 100 ppm
G3: 150 ppm
G4: 200 ppm

Factor II: Immersion With Water Temperature Different [S] which consists of 3 levels, namely:

S1: ± 27-30 °C [room temperature]
S2: 60 ° C
S3: 90 ° C

2.4 Data Analysis

The data obtained to determine whether there is any effect of treatment and the existence of treatment interactions, tested by analysis of variance at the 5% level. For further testing using the DMNRT [Duncan's New Multiple Range Test] tests.

2.5 Implementation Procedure

2.5.1 Seed Selection. The research procedure is seed selection carried out by selecting physiologically ripe seeds and of good quality, namely the seed coat is dark red, has uniform size and color, the surface of the skin not defective, free from pests and diseases. After obtaining the required seed, namely, 720 robusta coffee seeds, cleaned the seed coat using a knife, while peeling the seed coat, do not injure the seed. Wash the peeled seeds with distilled water.

2.5.2 Manufacture Hormone Gibberellin. The concentration of the hormone gibberellin is made by diluting concentrated gibberellin using distilled water with the formula M1. V1 = M2. V2.

2.5.3 Immersion Treatment. Robusta coffee seeds are soaked for 30 minutes in a cup containing the predetermined gibberellin hormone which has been labeled according to a predetermined concentration of 50 ppm, 100 ppm, 150 ppm, and 200 ppm. After soaking for 30 minutes with gibberellin hormone, previously soaking it with water temperature treatment for 30 minutes of Hardiyanto [5].

2.6 Parameter Observation

After that observed the seed observation. Measurement parameters are maximum growth potential [%], First Count Test [FCT] [%], and Index Value Test [IVT] [days].

3. Results and discussion

3.1 Index Value Test

Table 1. Index Value Test of Coffe Seed Germination

Gibberellin	Water Temperature			Average
	S1 [Room Temperature]	S2 [60 °C]	S3 [90 °C]	
G1 [50 ppm]	0.64	0.03	0.00	0.22
G2 [100 ppm]	0.66	0.01	0.00	0.22
G3 [150 ppm]	0.65	0.00	0.00	0.22
G4 [200 ppm]	0.79	0.01	0.00	0.27
Average	0.68 a	0.01 b	0.00 b	

Note: Numbers followed by different letters on the same line show significant differences according to Duncan's Multiple Distance Test at $\alpha = 5\%$

Table 1. shows the parameter index value test of gibberellin concentration at different water temperatures. Based on the table, the value test index has a significant effect on water temperature treatment. In table 1, it is found that the highest data is in the G4S1 treatment which is 0.79 days. In the index value test data, it is intended to see the seeds of coffee plants germinating normally with germinating days of gibberellin hormone treatment and different water temperatures.

The index value test is an observation to determine the condition of seed vigor or the ability to grow per unit time. The faster the seeds can germinate, the better the index value test will be. The index value test is related to the speed of seed growth and the ability for seeds to germinate normally. This is supported by the statement of Sutopo [14] which states that seed germination provides the ability for seeds to grow normally into reasonable plants in optimum biophysical conditions.

3.2. First Count Test

Table 2. First Count Test of Coffe Seed Germination

Gibberellin	Water Temperature			Average
	S1 [Room Temperature]	S2 [60 °C]	S3 [90 °C]	
G1 [50 ppm]	40.00	0.00	0.00	13.33
G2 [100 ppm]	45.00	0.00	0.00	15.00
G3 [150 ppm]	56.67	0.00	0.00	18.89
G4 [200 ppm]	76.67	0.00	0.00	25.56
Average	54.58 a	0.00 b	0.00 b	

Note: Numbers followed by different letters on the same line show significant differences according to Duncan's Multiple Distance Test at $\alpha = 5\%$.

Table 2. The treatment has a significant effect. The observation of normal sprouts showed that the highest first count test data was found in the G4S1 treatment, which was 76.67%. In table 2, the water temperature treatment has a significant effect, where the highest data is found in the S1 treatment, namely room temperature of 54.58%, and the lowest data is in the S2 and S3 treatments, namely 0.00%. The S1 treatment is significantly different from the S2 and S3 treatments in which the treatment has an impact on coffee seed germination for future coffee plant seed development.

The parameters that have been carried out show that the first count test at normal temperature is significantly different with a treatment temperature of 60°C and a treatment temperature of 90°C. In this case, the room temperature condition in the first count test is the best at room temperature, which is 54.58%, where the temperature conditions being heated at 60 °C and 90 °C can cause the seeds to damage the embryo and endosperm and cause the coffee seeds not to germinate. and some of the seeds are damaged so that abnormal growth occurs. Damage to the physical condition of the injured seeds and changes to several macro compounds that function as energy sources in the seeds into other metabolites and damage to cells and tissues. Furthermore, Sumayku [13] stated that the decrease in vigor is a physical, physiological, and biochemical change which as a result can cause loss of seed vigor and vigor.

3.3. Maximum Growth Potential

Table 3. Maximum Growth Potential of Coffe Seed Germination

Gibberellin	Water Temperature			Average
	S1 [Room Temperature]	S2 [60 °C]	S3 [90 °C]	
G1 [50 ppm]	75.00	15.00	3.33	31.11
G2 [100 ppm]	76.67	16.67	3.33	32.22
G3 [150 ppm]	75.00	11.67	3.33	30.00
G4 [200 ppm]	85.00	8.33	3.33	32.22
Average	77.92 a	12.92 b	3.33 c	

Note: Numbers followed by different letters on the same line show significant differences according to Duncan's Multiple Distance Test at α = 5%.

Table 3. shows the maximum growth potential parameters of gibberellin concentrations at different water temperatures. Based on the table, the maximum growth potential has a significant effect on water temperature treatment. In the table above, it is found that the highest data on G4S1 treatment is 85.00% and the lowest data is in the G1S3, G2S3, G3S3, and G4S3 treatments which are 3.33%.

In the treatment, the maximum growth potential to see the condition of the seeds that germinate entirely, both normal and abnormal, which is used because if not suitable condition environment can have an impact on the condition of the seeds that cannot germinate even though they have been given treatment to support the germination of these seeds. The optimal water content ranges from 21 - 27% in which conditions or below the seeds can germinate well, this is following the journal from of Arif and Akbar [2], namely the moisture content of seeds which is considered ideal for the germination process ranges between 21 - 23% because too low a water content will not activate the enzymes that promote germination, whereas a higher water content can be harmful to the embryonic condition of the seed causing the seeds to grow abnormally.

4. Conclusion

Index Value Test, First Count Test, and Maximum Growth Potential highest was the treatment of 200 ppm gibberellin hormone concentration. with room water temperature [G4S1] namely 0.79 days, 76.67 %, and 85.00 %.

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