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Effect of Seed Treatment on Hydration-Dehydration Respiration Sprouts Sorghum

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***Abstract*—** *The limiting factor affecting sorghum production in Indonesia is the rapid decline of sorghum seeds, it is necessary to do invigorate one way to hydration-dehydration. The purpose of this study was to know that invigorates with the hydration-dehydration method can increase the respiration rate of sprouts sorghum. This experiment using a completely randomized design (CRD) with 3 treatments and 4 replicates in order to obtain 12 units of trials conducted at the Laboratory of Seed Science and Technology, the University of Andalas from January to March 2019, The treatment in this trial are: A = low-quality seeds, B = Hydration for 1 hour and dehydration for 6 hours at a temperature of 400C, C = high-quality seeds. The data were analyzed by the F test significance level of 5%. If they are real continued by Honestly Significant Difference (HSD) at 5% level. The results showed that hydration-dehydration can increase the respiration rate of sorghum seedlings which have been in decline, from respiration rate 67,434mgCO_2 be 82,412mgCO_2.*

***Keywords*—** **hydration-dehydration, seed deterioration, sorghum seeds, viability, respiration sprouts.**

I. INTRODUCTION

Sorghum is a crop that is potentially good for food, feed, and industrial. Research on sorghum has been carried out, both in terms of plant breeding and cultivation. However, research on quality sorghum seed is still very little. According to Fatonah (2015) one of the limiting factors that affect the development and production of sorghum in Indonesia is the rapid decline of sorghum seed (deterioration). While the main requirement is to use the plant to increase the production of quality seeds, including sorghum.

Efforts should be made to overcome the problem of deterioration in sorghum seeds are invigorated. Invigorate seed is the treatment given to the seed before planting to improve germination and seedling growth (Koes and Arief, 2010). Invigorate method that has been was done on sorghum will be: Osmo conditioning, bio-matrix conditioning, and hydration-dehydration (Rini et al., 2005; Sutariati et al., 2011; Mutia, 2018).

One method is hydration-dehydration invigorate. According to Mutia (2018) hydration-dehydration is a moisturizing treatment or soaking the seeds in a given time followed by drying the seeds until it returns to its original weight. Seed by hydration-dehydration treatment proved to have a germination percentage, the maximum growth potential, germination first count, and test emerging land, and the index value higher than the seed without hydration-dehydration. This shows that invigorate with hydration-dehydration means it can optimize seed viability that has been stored for 8 months (Nurmauli and Nurmiaty, 2010). in general, if the germination of seed germination is high then the respiration rate will also be higher.

II. MATERIALS AND METHODS

This experiment was conducted at Seed Technology Laboratory Science starts from January to March 2019. The experiment is using a completely randomized design (CRD) with 3 treatments and 4 replicates to obtain 12 units of trial. The treatment in this trial are: A = low-quality seeds, B = Hydration for 1 hour and dehydration for 6 hours at a temperature of 400C, C = high-quality seeds. Quantitative data were analyzed using the F test significance level of 5% if there is significant then tested further by using test HSD 5%, while the qualitative data were analyzed descriptively.

a. Germination / DB (%)

The purpose of this test is to determine the viability of seeds to see the percentage of seeds that germinated. The percentage of normal germination seeds that can be generated by certain environmental conditions within a predetermined period. Observations were carried out by

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observing the normal germination, abnormal sprouts, seeds dormant and dead seeds in which the first observations made on the 4th day after the seeds germinate and the last observation on the 10th day.

b. The Maximum Growth Potential (%)

The Maximum Growth Potential is the percentage of germination seeds (normal or abnormal germination). The Maximum Growth Potential is a measure of the total viability that showed the ability to grow.

c. Germination First Count (%)

This test aims to determine the vigor of seeds by the rate of seeds germination on the first day of observation. This observation at the 4^{th} day after germination by counting the number of normal germinated seeds.

d. Respiration rate analysis Sprouts (Yulinda, 2000)

The seeds germinated in an airtight jar. The jar is placed in a container of 0.2 N KOH solution of 20 ml, then the jar was sealed and incubated for 24 hours. After an incubation period of respiration measurement is done by moving the KOH solution into the flask and add 1 drop of phenolphthalein and titrated with 0.4 N HCl until the pink color is gone, then add 1 drop of methyl orange, and titrated again with HCl until the color changed to the orange color pink. CO2 production is calculated based on the volume of HCl used. In determining the endpoint done carefully because the color change is not too obvious. Respiration rate sprouts were observed daily for five days, then summed.

III. RESULT

a. Germination

Results obtained from observations of normal and abnormal germination in seeds of sorghum on the various treatments showed significantly different effect after analyzed using ANOVA. The observed data normal and abnormal germination can be seen in Table 1.

Based on Table 1 it can be seen that the percentage of normal germination on low-quality seed treatment (55%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (75%) and high-quality seed treatment (97.5%). This means that hydration-dehydration does germination percentage increased by 20%. It can be concluded that hydration-dehydration treatment can improve the germination of seeds in a seed lot. This is by the opinion of Mutia (2018), hydration-dehydration treatment can improve normal germination of seeds. Judging from normal germination percentage of the seeds, the treatment of 1-hour hydration and treatment of dehydration to 6 hours of high-quality seeds have a difference in the value of 22.5%. It can be said that the hydration-dehydration treatment can increase seed germination percentage,

The seeds were used in this study with the seed germination rate of 55%. After the hydration-dehydration seed germination to 75%. Hydration-dehydration treatment is a treatment to make the germination process occurs early, with a hydration-dehydration treatment imbibition process occurs earlier. As it is known that the germination process begins with a faster imbibition process will result in the next process occurs early, such as the outbreak of the seed coat, the activation of enzymes and hormones, change in food storage, transport of nutrients, assimilation, respiration, and growth. Kamil (1982), stating that the initial process of germination is imbibition, namely the entry of water into the seed so that the water content in the seed reaches a certain amount. Water is needed in the optimal amount so that germination can take place optimally. Water is needed in the process of germination, with the entry of water into the seed with the seed metabolism will soon begin

Based on observations in Table 1 percentage germination abnormal low-quality seed treatment (12%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (4%) and quality seed treatment high (0%). This means hydration-dehydration treatment can decrease the percentage of abnormal germination of seeds of sorghum, but not yet on par with a high-quality seed treatment. In line with the opinions Mutia (2018), hydration-dehydration treatment in one lot of seeds can lower abnormal germination of seeds.

One indicator that states of quality seeds are the number of abnormal sprouts. The low-quality seed is usually characterized by a large number of abnormal sprouts. This is in line with the opinion of Copeland and McDonald (2001) which states that the aging process or pullback vigor physiologically is characterized by a decrease in germination, increase the number of sprouts abnormal, decreased appearance of sprouts in the field (field emergence) inhibition of plant growth and development, increased sensitivity against extreme environments that ultimately can reduce crop production.

b. Dead Seeds and Maximum Growth Potential (%)

The results obtained from observing the percentage of dead seeds and the maximum growth potential in sorghum seeds in different treatments showed significantly different effects after being analyzed using ANOVA. The data were dead seed and

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seed the maximum growth potential can be seen in Table 2.

Based on Table 2 it can be seen that percentage of dead seed in low-quality seed treatment (33%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (21%) and high-quality seed treatment (2.5%). Therefore it can be said hydration-dehydration treatment in one lot of seeds can decrease the percentage of dead seeds. This is by the opinion of Mutia (2018), hydration-dehydration treatment in one lot of seeds can decrease the percentage of dead seeds, but not yet on par with a high-quality seed treatment.

Dead seeds are seeds that germination until the end of the germination period are not able to germinate and not be in a dormant state. The percentage of dead seeds on sorghum seed that has been treated with hydration-dehydration can be said to be lower than that of the untreated hydration-dehydration. Hydration-dehydration treatment to condition the seed germination of early experience. Seed germination process begins with the imbibition faster will result in the next process to occur earlier. Therefore, these conditions can lower the percentage of dead seeds.

One of which led the seed dies are a pathogenic attack. Pathogens is a living entity that can lead to disease. All classes of pathogens such as fungi, bacteria, viruses, and nematodes can be carried by seed. Fungus usually attacks the seeds on the surface, the bacteria usually attack the seed on space between cells, while the bias virus directly attacks the cell nucleus.

Microorganisms (bacteria and fungi) can grow and develop rapidly in sorghum seeds to become pathogens. This can cause the seeds into nonperishable and grow abnormally. In this study, there are some seeds of sorghum seed fungus causing death as in Figure 1. The high percentage of dead seeds were allegedly caused by the fungus possibility depleted embryo or seed endosperm is absorbed by the fungus so that when the size of the split seed endosperm found very little. This is by the opinion Mardinus (1998), explains that the pathogens attack not only damages the seed endosperm, but also disrupt the growing point of the embryo that sprouts new growth becomes abnormal and unable to penetrate the soil surface.

Based on Table 2 it can be seen that the percentage of maximum growth potential in the treatment of low-quality seed (67%) were significantly different from the treatment of dehydration hydration 1 hour 6 hours (79%) and high-quality seed treatment (97.5%). This means that by doing hydration-dehydration percentage of maximum growth potential increased by 12%. By the opinion of Mutia (2018), hydration-dehydration treatment can increase the percentage of the maximum growth potential. Judging from the percentage of the maximum growth potential, hydration treatments 1 hour 6-hour dehydration and treatment of high-quality seeds have a difference in the value of 18.5%. It can be said that the hydration-dehydration treatment can increase the percentage of the maximum growth potential, but not yet on par with a high-quality seed treatment.

The maximum growth potential is a measure of the total viability of the seeds, the seeds can germinate (life) and the metabolic processes that occur. This is due to the PTM benchmarks only measure the ability of seeds to grow just normal, although not yet germinated, resulting in less showed no significant differences in the evaluation of the test results. The maximum growth potential value of the total viability of a seed, it shows symptoms of a life marked by the appearance of the radicle and hypocotyl elongation. The maximum potential value growth will be greater than with germination.

The viability and vigor is irreversible, it applies to a single individual. Increased viability contemplated in this study is viability in a seed lot where an increase in value by 12% viability. Allegedly 19.33% seed is a seed that is sick and damaged membranes. After being given the care with hydration-dehydration treatment, water entering the hydration-dehydration treatment could organize existing cell membrane, activating enzymes and organelles especially mitochondria. With active mitochondria, the respiratory process is underway and accelerated by enzymes that will remodel the existing food reserves in the seed be simple molecular compounds to be translocated to the embryonic axis so that the seed that was capable of germination pain well. So point average decline in vigor and viability lines can be enhanced so that the line which was originally sharp decline can slowly down. Bustamam (1989) cit. Putih et al., (2009) stated that with the seed metabolism active ingredient food reserves lasted overhaul and produce energy for translocated to the embryonic axis and plumula radicle to the formation and also to support the growth of early germination.

c. Germination First Count (%)

The germination first count is one of indicator in determining seed vigor. The percentage of germination first count would indicate that high seed vigor. The seed that has high vigor will grow normally in the field according to suboptimal field conditions. Results obtained from observations of sorghum seed germination first count on a variety of treatments showed significantly

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different effect after analyzed using ANOVA. The data were germination first count percentage can be seen in Table 3.

Based on Table 3 it can be seen that percentage germination first count on low-quality seed treatment (55%) was significantly different from 1-hour hydration treatment of dehydration 6 hours (75%) and high-quality seed treatment (97.5%). Hydration-dehydration treatment can improve the germination first count. This is in line with Mutia (2018) seed hydration-dehydration treatment to give effect to an increase in the percentage of the first count. Judging from the first count germination percentage, hydration treatments 1 hour 6-hour dehydration and treatment of high-quality seeds have a difference in the value of 22.5%. It can be said that the hydration-dehydration treatment can increase the percentage of germination first count, but can not be the same as the treatment of high-quality seed.

Hydration-dehydration can cope with variations in the level of initial absorption of water on the seed. All seeds are likely to reach the level where the seeds are ready to germinate in unison when positioned in the optimum condition. Differences germination first count is determined by the seed's ability to absorb water and the level of damage to the membrane, where the availability of water that has been able to increase the optimal seed germination percentages of the first count, in this case, means faster seed germination.

Hydration-dehydration treatment on sorghum seed which has undergone deterioration can improve the vigor. Although fundamentally the line vigor or viability line will never come back, with a hydration-dehydration treatment averaged point increase in height, so that the line which was originally sharp decline will be stripped. Sadjad (1979) states that the periodization viability and vigor, the period to three or critical period marked by a sharp decline in seed vigor and predated the potential viability.

d. Respiration rate of Sprouts

Results obtained from observations of the respiration rate of germination at different levels of quality sorghum seeds showed a significantly different effect after analyzed using ANOVA. The data were the respiration rate of germination can be seen in Table 2.

Based on Table 2 can be seen that respiration rate of germination on low-quality seed treatment (67.434mgCO2) Significantly different from the treatment of dehydration hydration 1 hour 6 hours (82.412mgCO2) And high-quality seed treatment (98.516mgCO2). Judging from the respiration rate of germination, treatment of dehydration hydration 1 hour 6 hours and low-quality seed treatment has a difference of 14.978 values. It can be said that the hydration-dehydration treatment may accelerate the rate of respiration, but not yet on par with a high-quality seed treatment.

Respiration rate lower seed during storage can prevent a decline in seed quality and vigor can be kept high (Tambunsaribu et al., 2017). Low-quality seed respiration slow pace due to the deposit of the seed is experiencing respiratory quickly so that the food reserves in the seed has been reduced. Therefore, the energy used to germinate seeds is low, so that poor seed germination.

This is in accordance with the opinion of Justice and Bass (2002) argued for the seed is stored, a process of respiration in the seed, so the food reserves contained in the endosperm, which is used as an energy reserve in the next seed growth process has been overhauled so that a reduction in food reserves. According to Nurfarida (2011) the relationship between the benchmarks germination to seed respiration rate was positively correlated, meaning that the higher seed germination rate, the higher the respirate. Germination high value indicates that the seeds have high potential viability of being able to utilize normal food reserves for germination optimum conditions.

Respiration is one of the stages of the process of seed germination physiology that occur after water absorption, digestion, food transport, and assimilation. If respiration is limited then germination will be slow. One cause limited respiration Utomo (2006), states that the water is necessary for germination, though soaking for too long can lead to loss of oxygen, thereby limiting the respiration process.

IV. FIGURES AND TABLES

Table 1. Percentage of germination Normal and Abnormal germination at Various Treatment

Treatment	Germination (%)	
	Normal	Abnormal
Low-Quality Seeds	55,000 a	12,000 a
1-hour hydration, dehydration 6 hours	75,000 b	4,000 b
High-Quality Seeds	97.500 c	0,000 c
KK	3.38	15.86

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

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Table 2. Percentage of Dead Seeds and Maximum Growth Potential on Various Treatment

Treatment	Dead Seeds (%)	Maximum Growth Potential (%)
Low Quality Seeds	33,000 a	67,000 a
1 hour hydration, dehydration 6 hours	21,000 b	79,000 b
High Quality Seeds	2,500 c	97.500 c
KK	13.59	3.15

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

Table 3. Percentage Germination First Count on Various Treatments

Treatment	Germination First Count (%)
Low Quality Seeds	55,000 a
1 hour hydration, dehydration 6 hours	75,000 b
High Quality Seeds	97.500 c
KK	3.38

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

Table.4: The respiration rate of germination at Various Levels of Quality Seeds of Sorghum

Treatment	Respiration rate of germination (mgCO2)
Low-Quality Seeds	67.434 a
1-hour hydration, dehydration 6 hours	82.412 b
High-Quality Seeds	98.516 c
KK	6.97

Information: The figures in the same column followed by different small letters indicate significantly different according to HSD test level of 5%

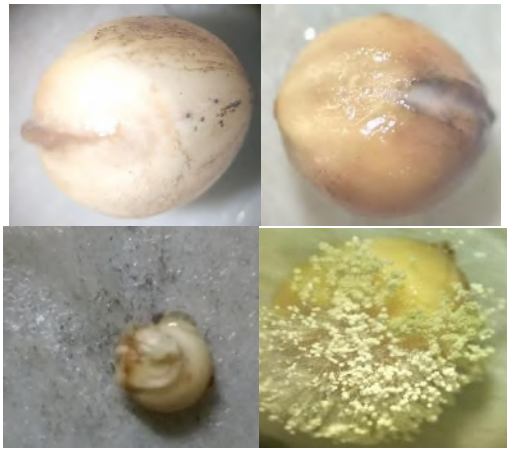

Fig. 1. Dead Plant Seeds Sorghum after 10 HSS

V. CONCLUSION

Hydration-dehydration can increase the respiration rate of sorghum seedlings which have been in decline, from respiration rate 67,434mgCO_2 be 82,412mgCO_2.

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