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Assesment of Viability of Sesame (*Sesamum indicum* L.) Seeds Using Germination Method with Paper Media

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Abstract

Seed viability is the ability of seed to germinate which is demonstrated by a variety of physiological or biochemical phenomena. Paper media can be used for testing seed viability. This study aimed to determine the most effective method of seed germination utilizing paper media for the viability of sesame seeds. The research was conducted at the Seed Laboratory of the Sweetener and Fiber Crops Research Institute, Malang in March – May 2020. The research method used a two-factor factorial Completely Randomized Design. The first factor was the sesame seed variety which consisted of SBR 1 and Winas 1. The second factor was the seed germination method which consisted of a test on top of paper, a test on rolled top papers, a test between of papers and a test between folded paper. Each treatment was replicated four times, resulting 32 experimental units. Sesame seed viability was significantly affected by the manner of seed germination using paper media, according to the findings. In comparison to other treatments, sesame seeds of the Winas 1 variety exhibited the highest percentages of simultaneous growth, germination, vigor index, normal seedling dry weight, hypocotyl length, and radicle length when tested on rolled top paper

Keywords: *Sesamum indicum,* straw paper, sumberrejo 1, winas 1

A. Introduction

Sesame is an oil-producing plant that may be grown in tropical and subtropical areas. Sesame seeds are made up of 50-53% vegetable oil, 20% protein, 7-8 crude fiber, 15% nitrogen-free residue, and 4.5-6.5% ash. Sesame seed oil is rich in unsaturated fatty acids, particularly oleic and

linoleic acids, anti-oxidants alanine or lignin, vitamins B and E, and cholesterol-free. In the meantime, protein can be isolated from sesame seed hulls and used as an animal feed ingredient. Therefore, sesame oil production in Indonesia needs to be increased, one of which is through the use of high quality seeds. High-quality seed is the most important factor in agricultural production success because it produces high yields of high-quality products (Wiguna, 2013).

The quality of seeds include physical, genetic, and physiological qualities. Physical quality is determined by the seeds' cleanliness, shape, size, color uniformity, and absence of mechanical or pest-related damage. Genetic quality based on the level of purity. Meanwhile, physiological quality is measured from seed viability, moisture content, and seed storability. Seed viability is the ability of seeds to grow, as evidenced by a variety of physiological and biochemical phenomena, which can be evaluated using these phenomena. Through physiological, biochemical, and cytological approaches, the indication of seed viability demonstrates that the seeds are alive (Widajati, E., Endang, M., Endah, R. P., Tatiek, K., Syhartanto, M. R., Abdul, Q., 2017).

The physiological approach is the evaluation of growth changes, whereas the biochemical approach is the evaluation of the metabolic activity of seeds, such as the ability of enzymes to catalyze the metabolic activities of germination, respiration, ATP synthesis, and son so. Through the condition of chromosomes, cell membranes, mitochondria, etc., a cytological approach can be recognized. The mathematical approach, on the other hand, is a concept based on observations of seed viability benchmarks that have been translated into mathematical formulas and may be used to forecast viability quickly (Widajati *et al*., 2017).

Germination assays can be used to assess the physiology of seeds, although they can only determine the percentage of normal germination on optimal germination media and often employ paper or sand substrates (Hidayat RS and Mayasari, 2019). Commonly employed papers include filters, blotters, and towels (ISTA, 2010). However, the three substrates are highly costly and must be imported for their procurement. Therefore, an alternative substrate medium was produced from straw paper and has been recommended for use in Indonesian seed testing (Sadjad, 1972 in Hidayat RS and Mayasari, 2019). According to Purbojati and Faiza (2006), straw paper has the highest degree of resemblance, at 97.22 percent, followed by stencil paper at 88.87 percent.

Alimoeso and Sutarto (2006) suggested that the approach for determining germination or growth potential could employ the top of paper (on paper), between paper (between paper), or planted paper (between paper fans). The rolled-up paper established with plastic (UKDdp) test method is most commonly used for seed testing with parchment paper. According to Hapsari and Suwarno (2008), stencil paper can be used as a substitute for straw paper when using the UKDdp method to verify seed viability. Based on Suwarno and Deni (2009), the efficiency of testing the viability of large and small seeds can be done by using two sheets of parchment paper for germination variables. The germination method and paper substrate significantly affected the viability of E. pellita seeds utilizing the test method on paper (UDK), which produced higher germination values (Yuniarti, N., Megawati, Budi, L., 2017). The germination of maize seeds of the Anoman, Bisman, and Srikandi varieties was identical using the UDK, Udk, and UKDdp techniques (Nurhafidah., Abdul, R., Abbas, K., Hasyim, H.J., 2021).

Prior to usage, the germination rate of sesame seeds categorised as having a long shelf life or exhibiting dormancy were evaluated for viability testing. Several varieties of sesame which are classified as superior are SBR 1 and Wirnas 1. Local sesame varieties Sumberejo 1 (SBR 1) are the result of negative mass selection. This variety can be grown on dry soil and rice fields with limited water, can be harvested at 105 DAP, and contains between 55 and 58 percent oil. The Wirnas is an excellent sesame cultivar with a potential yield of 2.2 tons per hectare, an oil content greater than 50 percent, drought tolerance, and early maturity. Therefore, this variety can be cultivated on paddy fields using crop rotation.

This study aims to determine the viability response of sesame seeds using parchment paper, to identify a seed germination method using straw paper that is effective against sesame seed viability, and to obtain sesame varieties with the highest viability using straw paper.

B. Methology

This study was conducted between March and June of 2022 at the Seed Laboratory of the Research Institute for Sweeteners and Fibers in Malang, East Java. The materials and equipment used were sesame seeds of the SBR 1 variety in 2015 and Winas 1 variety in 2016, as well as straw paper, petri dishes, plastic, scissors, rubber, and a germinator.

This study employed a Two-Factor factorial Completely Randomized Design (CRD). The initial variable was sesame seed variety, which consists of SBR 1 and Winas 1. The second aspect was the method of seed germination using straw paper, which included tests on paper, rolled paper, between papers, and folded papers. The test on paper was conducted by placing the straw paper in a 9 mm-diameter petri dish. In the test of seeds on rolled paper, seeds sprouted on straw paper, which was subsequently rolled and erected during the germination phase. Seed testing between paper was done by germinating sesame seeds between straw paper. While the seed tests between folded paper, the seeds were germinated on folded paper and a shaped fan-like structure. The experiment included four replications and eight treatment combinations, yielding 32 experimental units. Each treatment was evaluated with 400 seedlings (ISTA, 2010). Germination was conducted in a type 72 IPB germinator at temperatures between 25 and 30 degrees Celsius.

The variables observed were the percentage of simultaneous growth (%), growth speed (% KN/etmal), germination (%), vigor index (%), normal seedling dry weight (g), hypocotyl length (cm), and radicle length (cm). The first observation was carried out on the 3rd day and the second observation on the 6th day after germination (Balittas, 2016). Experimental data were analyzed using analysis of variance (F test) with SAS 9.1 software. The F test results that were significantly different were further tested using the Duncan Multiple Range Test (DMRT) at the 5% level.

C. Result and Discussion

Simultaneous growth and the speed of seed growth are indicators of seed vigor. Seed vigor is the ability of seeds to develop rapidly and generate healthy plants in adverse conditions (Asra, 2014). The speed of seed growth reveals the strength of vigor required to produce seeds that can survive in inadequate environmental conditions (Fatikhasari, Z., Intani, Q.L., Dian, S., Muhammad, A.U., 2022). Table 1 displays the observed parameters for the simultaneous growth (percent) and growth rate (percent/etmal).

Table 1. Percentage of simultaneousness and speed of seed growth on varieties and methods of germination of sesame seeds (*Sesamum indicum* L)

Treatments		Simultaneous Growth (%)	Growth Speed (%/etmal)
Varieties	Germination method		
SBR 1	Test on paper	47.5 c	36.0 d
	Test on rolled paper	94.5 a	44.3 bc
	Paper-to-paper test	94.0 a	56.0 a
	Test between folded paper	82.0 b	43.8 bc
Winas 1	Test on paper	54.5 c	32.5 e
	Test on rolled paper	97.5 a	45.5 bc
	Test on paper	93.5 a	46.5 b
	Test on rolled paper	90.5 ab	42.5 c
Coefficient of Diversity (%) (%)		8,69	14,02

Note: The numbers followed by the same letter indicate that the DMRT test results are not statistically different (α 0.05).

Table 1 demonstrates that the Winas variety with the rolled paper germination test method has the highest percentage of simultaneous growth at 97.5% and is not substantially different from the SBR 1 variety with the inter-paper germination test method. In contrast to the best growth rate parameter, however, the SBR 1 variety's inter-paper germination test result was 56.0%/etmal. This revealed that the use of the germination procedure to the to the tested sesame seed varieties had no significant influence on germination. According to Nurhafidah *et al*. (2021), one of two germination procedures can be used to germinate corn. Tefa (2017) states that the speed of growth is regulated by water content and shelf life.

Germination or absolute viability benchmark that replicates potential viability is the capacity of a seed to develop into a normal plant that produces normally under optimum conditions. The vigor index is a metric that measures the uniformity and speed of germination. Table 2 presents the results of observations about the germination, vigor index, and normal seedling dry weight.

Table 2. Percentage of germination, vigor index and normal seedling dry weight of varieties and germination methods of sesame seeds (*Sesamum indicum* L.)

Treatments		Germination (%)	Vigor Index (%)	Normal Seedling Dry Weight (g)
Varieties	Germination method			
SBR 1	Test on paper	93.0 cd	91.5 a	0.1248 b
	Test on rolled paper	96.5 abc	97.5 a	0.1298 ab
	Paper-to-paper test	94.5 bcd	96.0 a	0.1185 bc
	Test between folded paper	93.0 cd	94.5 a	0.1045 d
Winas 1	Test on paper	91.5 d	85.0 b	0.1105 cd
	Test on rolled paper	98.5 a	98.0 a	0.1418 a
	Paper-to-paper test	96.0 abc	95.5 a	0.1185 bc
	Test between folded paper	97.5 ab	97.5 a	0.1403 a
Coefficient of Diversity (%)		8,69	14,02	

Note: The numbers followed by the same letter indicate that the DMRT test results are not statistically different (α 0.05).

Using the germination test on rolled paper (UDKd), the Winas 1 variety generated the highest percentage of germination, vigor index, and normal seedling dry weight, which were 98.5 percent, 98 percent, and 0.1418 grams, respectively. Seed vigor properties indicate a seed's capacity to grow rapidly, normally, and uniformly. According to Fatikhasari *et al*. (2022), a decline in vigor index and germination is a physiological sign of deteriorating seed quality. In the meanwhile, biochemical indicators include a reduction in enzyme activity, food reserves, and an increase in conductivity levels. Based on Purbojati and Faiza (2006), the best germination and vigor indices for sesame seed germination were 98% and 96.80%, respectively, when straw paper medium was used. Rahayu and Titiek (2015) observed that the use of straw paper substrate did not show a significant difference with filter paper substrate.

The hypocotyl is the part of the embryonic axis between the cotyledons and the primary root which becomes the stem of the sprout. While the radicle, which is the lower end of the hypocotyl in the embryo that will develop into the primary root of the sprout, is presented in Table 3. Table 3 shows that the Winas 1 variety using the germination test on rolled paper (UDKd) resulted in the best hypocotyl and radicle lengths of 3.87 cm and 8.20 cm, respectively. The existence of hypocotyl and plumule development proves that the sprouts formed are normal sprouts. The hypocotyl growth is healthy and flawless, with no tissue injury. Plumule growth is ideal, as it has green leaves, grows well within or exits from the coleoptile, or has complete epicotyl growth and typical buds. According to Wibowo (2020), the type of paper and the interaction between panted paper and paper type influence the parameters of the average length of the radicle and plumule.

Table 3. Hypocotyl length and radicle length on varieties and germination methods of sesame seeds (*Sesamum indicum* L)

Treatments		Hypocotyl Length (cm)	Radicle Length (cm)
Varieties	Germination method		
SBR 1	Test on paper	2,73 b	3,30 d
	Test on rolled paper	3,00 b	6,85 b
	Paper-to-paper test	2,90 b	4,73 c
	Test between folded paper	2,45 b	5,30 c
Winas 1	Test on paper	3,85 a	4,68 c
	Test on rolled paper	3,87 a	8,20 a
	Paper-to-paper test	3,83 a	6,33 b
	Test between folded paper	3,67 a	5,18 c
Coefficient of Diversity (%)		8,69	14,02

Note: The numbers followed by the same letter indicate that the DMRT test results are not statistically different (α 0.05).

Hidayat RS and Marjani (2020) suggested that the process of cell differentiation will follow the development of new cells in the embryo. As a result, the plumule, which consists of the stem and leaves, and the radicle, which is the root, are created. The growth of the radicle from the seed begins with the absorption of water into the seed coat, which causes the skin to swell and break. This is followed by germination, which is signified by the release of the radicle.

D. Conclusion

Sesame seed viability was significantly affected by the method of seed germination using paper media. Compared to other treatments, Winas 1 sesame seeds exhibited the highest percentage of simultaneous growth (97.5%), germination (98.5%), vigor index (98%), normal seedling dry weight (0.1418 g), length of hypocotyl (3.87 cm), and radicle length (8.3 cm).

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