



The Vigor and Viability Seed Testing of Three Tobacco Varieties on Various Seed Germination Media

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Abstract

Seed viability is one of the most important physiological quality benchmarks of seeds. The use of appropriate germination media can affect the results of seed viability testing. This study aims to determine the optimal germination media in tobacco seed viability testing. This research was conducted at the Seed Laboratory of the Indonesian Sweetener and Fiber Crops Research Institute, Malang in January - March 2019. The research method used a two-factorial randomized block design (RAK). The first factor is tobacco seed varieties consisting of Kasturi in 2007, Bojonegoro in 2012 and Kemloko in 2014. The second factor is the seed germination media consisting of straw paper, cotton, towel tissue, paperboard and newspaper. The results showed that the Kemloko variety of tobacco seeds germinated in the towel tissue had the best seed vigor and viability percentage. Seed germination media with paperboard, towel tissue and straw paper can be used to test the viability of tobacco seeds because they have a percentage of simultaneous growth, percentage of the growth speed, percentage of germination, percentage of the growth potential maximum and normal seedling dry weight which are equally well

Keywords: germination, kemloko, paperboard, towel tissue, straw paper

A. Introduction

One of the leading commodities of smallholder plantations in East Java Province is tobacco (*Nicotiana tabacum* L.). This commodity is quite a big contribution to the national economy and can indirectly have an impact on the social and cultural aspects of society. In the international world, Indonesia is the sixth largest tobacco leaf producing country after China, Brazil, India, the United States, and Malawi. In 2017, the tobacco plantation area in Indonesia reached 201,909 Ha and production reached 180,929 tons. Tobacco development is carried out in 14 provinces and

East Java is the highest tobacco producing province, which is around 79,442 tons in 2017, and production is estimated to increase to 85,053 tons in 2019 (Direktorat Jenderal Perkebunan, 2018).

Utilization of tobacco plants is not only a raw material for cigarettes but can also be used as antioxidants and larvicides (Handayani, S.W., Prastowo, D., Boesri, H., Oktsariyanti, A., Joharina, A.S., 2018), bioinsecticides (Paramartha and Lazurdi, 2013); (Siswoyo, E., Masturah, R., Fahmi, N., 2018), even to soundproofing materials (Fransiska, Windy A., Sari, O.K., Hardiansyah, Nugroho, D., 2015). One of the problems in developing tobacco plants is the provision of quality seeds (Rachman, 2007). In the rainy season, farmers usually store their tobacco seeds from their own plants at room temperature and humidity conditions that are not suitable for seed storage. According to (Sutopo, 2004) that the optimum temperature in long-term seed storage ranges from -18°C - 0°C. Changes in temperature conditions during storage can cause a decrease in seed quality. Tobacco seeds must meet the quality requirements of scattered seeds with a percentage of germination power $\geq 85\%$ and percentage of moisture content 6-8% (BSNI, 2006). According to Hasanah (2002) that the use of seeds with high seed viability can reduce production costs for replanting and increase crop productivity.

Seed viability testing is carried out to determine the physiological quality of seeds using appropriate germination media. Testing viability of seeds such as germination requires optimum conditions on germination media, temperature and humidity. Terms of use of germination media must have good physical properties, have the ability to absorb water and oxygen, and are free from disease-causing microorganisms. The germination media substrates in seed quality testing vary, depending on the testing method, size and type of plant seed (Susanti, 2010). Some germination media commonly used are paper substrate, sand, compost and organic media. Based on recommendation of International Seed Testing Association, 2014), the paper substrate for seed germination media used is filter paper, filter paper, and tissue paper (towel). The use of paper media is quite difficult to apply in testing the seed germination because of the limited availability of paper material and the price is relatively expensive (Purbojati and Suwarno, 2006); (Rahayu and Suharsi, 2015).

Each seed has a different shape and size and character so that the germination test uses different germination media. The use of appropriate germination media will correlate with the results of the test. The results of the Setiarini (2010) study showed that the pre-germination treatment for watermelon without seeds cultivar *New Lucky* is to moisten the seeds with water on paper straws for 2 days, then plant them on sand media or mix soil, sand and compost (3: 2: 1). Sand media can be used in testing the germination of corn seeds (Mapasiatta, 2014). In the Panggal Buaya (*Zanthoxylum rhetsa* (Roxb.)) Germination test using sand media, zeolite, soil mixture, compost, sand, cockopit and husk charcoal (Susanti, 2010).

Media germination using paper substrates for testing the seed germination has been done various studies including the use of paper straw in testing jute seeds (*Corchorus olitorius* L.) (Hidayat and Marjani, 2017); straw paper used in tobacco seed testing (Sumartini, S., Mulyani, S., Rochman, F., 2014) (Suroh, M., Rahayu, T., Hayati, A., 2017), Stencil paper can be used as a substitute for straw paper substrate (Suwarno and Hapsari, 2008); Newspaper substrate for testing the viability of *Eucalyptus pellita* seeds (Yuniarti, N., Megawati, Leksono, B., 2017); Paper CDs in testing winged bean seeds (Rahayu and Suharsi, 2015). According to Agustin and Lestari (2016) that germination media using flannelette, newsprint, samson paper, towel tissue, cotton, stencil paper, rock wool and filter paper are suitable for use in the viability test of lettuce and onion seeds. Research on appropriate germination media, especially paper substrates, is needed to obtain optimal test results on tobacco seeds. This study aims to determine the optimal germination media in testing the viability of tobacco seeds.

B. Literature Riview

1. Tobacco Development

The Tobacco Plant (*Nicotiana tabacum* Linn.) Is a plant native to the American continent and entered Indonesia about 400 years ago, so it has long adapted to the diverse growing. Adaptation which has become a culture has resulted in the emergence of popular types of tobacco known as the development area, such as Madura, Temanggung, Kendal, Selopuro, and others. Tobacco plants

cultivated in Indonesia are included in the *Nicotiana Tabacum* species and can be broadly grouped into two major groups namely introduced tobacco such as Virginia, Burley, Oriental and Cigar tobacco as well as local tobacco such as Madura, Temanggung, Weleri and others (Basuki and Yulaikah, 2006).

The development of tobacco in Indonesia itself began since the colonial era. In the colonial era, tobacco harvests were only used to be smoked by themselves in the form of rolled cigarettes themselves. After that, the cultivation continued to increase since tobacco was used as a raw material for the cigarette industry, so it became a commercial commodity. Some cigarette industries continue to grow after Indonesia's independence, so the area of tobacco cultivation is expanding, especially in East and Central Java (Djajadi, 2018).

Based on data from Direktorat Jenderal Perkebunan (2018) that the tobacco plantation area in Indonesia in 2017 reached 201,909 ha and it is estimated that in 2019 it will increase by 204,562 ha. While the total production of tobacco dried leaves in 2017 is 180,929 tons and is expected to increase in 2019 to 183,146 tons. East Java Province is the highest tobacco producing area, which is around 79,442 tons in 2017, and it is estimated that production will increase to 85,053 tons in 2019.

2. Tobacco seed

Tobacco seeds are obtained from tobacco fruit harvested. Tobacco fruit is oval with a length between 1.5 - 2 cm. When early plant, the fruit turns green and when it ripe become brown Inside the fruit contains many seeds that are very light weight. The fruit will be on the base of the flower and have 4 large spaces. Each room contains about 2.000-3.000 seeds of anatropical seeds. Color of tobacco seeds are dark brown. Weight of 1,000 seeds between 0,7-0,9 grams. This ovary will be connected by a pistil stalk with one head pistil on it. In general, each plant produces seeds of 7-10 grams from 75-100 fruit (Hamida and Rochman, 2018).

The level of maturity of each individual tobacco fruit is different and not uniform after the fruit enters fertilization for 3 weeks. Seeds from newly tobacco fruit harvested cannot germinate when planted because the tobacco seeds have a dormancy of around 2-3 weeks to germinate. This phase is referred to as partial dormancy (after ripening). Tobacco that is ready to be harvested must be in physiological mature condition so that the seeds can germinate with a percentage of about 95%. For the storage stage, tobacco seeds can be stored at 7-10 ° C, humidity 40-50%, and moisture content 7-8% (Ilyas, 2010).

3. Media of Seed germination

Germination media is one important factor that influences seed germination. The use of suitable germination media will make it easy for sprouts to grow and develop on the surface of the germination substrate. There are four types of germination media, namely germination media using paper, sand or organic material, soil, and a combination of paper and sand (Sudrajat, D.J., Nurhasbi, Bramasto, Y., Djoko Irianto, Zanzibar, M., Setio, P., 2015). According to ISTA (2014), paper substrates commonly used are filters, blowers and towels which are foreign products that must be imported and relatively expensive (Purbojati and Suwarno, 2006). Overall, the physical properties of the paper substrate it is the best, because it has a high absorption capacity, is uniform, is able to maintain water and the absorption rate of capillary water is high even though it fluctuates. Stencil and opaque paper / CD is a substrate paper that shows the ability to absorb water, maintain water and good water absorption speed, and has the potential to be used as an alternative substrate to replace straw paper (Suwarno and Hapsari, 2008).

The results of research related to germination media include to use of straw paper media for testing jute seeds (Hidayat and Marjani, 2017), kecipir seeds (Purba and Suharsi, 2017), tobacco seeds (Purba and Suharsi, 2017); (Sumartini et al., 2014). The result of research Suwarno and Hapsari (2008) used stencil paper as a substitute for straw paper. The Newspaper for testing the viability of *Eucalyptus pellita* seeds (Yuniarti et al., 2017) and CD paper in kecipir seed testing (Rahayu and Suharsi, 2015).

C. Methodology

1. Research Design

This research was conducted at the Seed Laboratory of Indonesian Sweetener and Fiber Crops Research Institute, Malang, East Java in January - March 2019. The ingredients used were variety

of tobacco seeds of Kasturi 2 in 2007, Bojonegoro 1 in 2012 and Kemloko 3 in 2014, straw paper, cotton, tissue towels, paperboard and newspaper.

This research uses factorial two-factor randomized block design. The first factor is tobacco seed varieties consisting of Kasturi 2 in 2007, Bojonegoro 1 in 2012 and Kemloko 3 in 2014. The second factor is the seed germination media consisting of straw paper, cotton, tissue towels, paper board and newspaper. The study consisted of 4 replications and 12 treatment combinations so that there were 60 experimental units. Each treatment was tested as many as 400 seeds according to the germination media using the UDK method (Test on paper) (ISTA, 2014) on a 9 cm diameter petri dish. Germination is carried out in a germinator type IPB type 72 with a temperature of 25-30°C.

2. Observation parameters

The observed variables were the percentage of simultaneous growth (%), percentage of the growing speed (% KN/etmal), percentage of germination (%), percentage of the maximum growth potential (%), seedling vigor index (%) and normal seedling dry weight (g). The first observation was made on the 7th day and the second on the 14th day after planting (Balai Penelitian Tanaman Pemanis dan Serat, 2016).

3. Data analysis

Experimental data were analyzed using analysis of variance (F test) with SAS 9.1 software. Significantly different F test results were further tested using the Duncan Multiple Range Test (DMRT) at 5% level.

D. Findings and Discussion

1. Percentage of simultaneous growth and growing speed

The ability of seeds to grow plants with good physiological vigor can be identified, one of which is from the parameters of simultaneity and speed of seed growth. Physiological vigor is indicated by the growth of radicles or roots and plumules or coleoptiles (Sutopo, 2004). The speed of sprout growth is observed based on germination every day, so that the percentage of seeds that produce sprouts can be obtained with the appearance of radicular and hypocotyl structures on the day of observation. Tobacco seed testing on various germination media showed a very significant effect on the percentage of growing simultaneity and speed of growth. Table 1 shows the percentage of simultaneity and the highest growth rate in the kemloko 3 variety of tobacco seeds which were added to paperboard (97,5% and 23,0%), tissue paper (97,5% and 22,8%) and straw paper (96,3% and 21,8%) which are significantly different from other treatments.

The germination media using paperboard, tissues and newspaper in the simultaneous testing and speed of growing tobacco seeds showed the highest results. This is caused by the high ability of the media to absorb and store water. One of the germination media that has the ability to absorb water is paper straw which reaches 46.5 g per media unit (Suwarno and Hapsari, 2008); (Suwarno and Santana, 2009). Even paper straw has a 100% similarity level in the test of growing simultaneity when compared with sand media. Cardboard paper can also be used as a good germination media because it can absorb water with a thickness of paper that has a high cellulose content (Sari, 2016).

Table 1. Percentage of simultaneous growth and growing speed of tobacco seeds in seed germination various media

Variety	Treatment	Simultaneous growth	Growing speed
	Seed germination media		
		(%)	
Kasturi 2	Straw paper	55,5 ^d	10,3 ^d
	Cotton	34,0 ^e	8,0 ^d
	Tissue towel	49,5 ^d	10,0 ^d
	Paper board	56,5 ^d	10,3 ^d
	Newspaper	51,5 ^d	9,8 ^d
Bojonegoro 1	Straw paper	20,5 ^f	4,3 ^e
	Cotton	23,3 ^f	4,8 ^e
	Tissue towel	26,3 ^f	4,5 ^e

	<i>Paper board</i>	23,8 ^f	5,0 ^e
	<i>Newspaper</i>	7,8 ^g	3,3 ^e
Kemloko 3	<i>Straw paper</i>	96,3 ^a	21,8 ^{ab}
	<i>Cotton</i>	76,0 ^b	16,5 ^c
	<i>Tissue towel</i>	97,5 ^a	22,8 ^a
	<i>Paper board</i>	97,5 ^a	23,0 ^a
	<i>Newspaper</i>	66,3 ^c	19,8 ^b
	Coefficient of variation (%)	8,69	14,02

Note: The numbers followed by the same letters in the same columns are not significantly different in the DMRT test $\alpha 0,05$

2. Percentage of germination and maximal growth potential

Seed germination and maximum growth potential are benchmarks of total seed viability as indicated by the ability of seeds to grow and live into normal and productive plants in optimum field conditions (Sadjad, S., Murniati, E., Ilyas, S., 1999). Testing the germination and maximum growth potential showed a very real effect on three varieties of tobacco seeds using various germination media. Percentage of germination and maximum growth potential was shown in the Kemloko 3 variety of tobacco seeds tested on paperboard (98.0% and 98.0%), tissue paper (97.5% and 97.5%) and straw paper (96,3% and 97.3%) (Table 2). These results show the highest results and are significantly different from other treatments.

The Kemloko 3 tobacco variety seed showed a better percentage of germination and maximum growth potential compared to the other two varieties. This is due to the fact that the tobacco seeds of the Kemloko 3 variety have a shorter storage period compared to other varieties. The storage time affects the germination of tobacco seeds, the longer the seeds are stored the germination will continue to decrease. This is consistent with the study of Suroh et al., (2017) that tobacco seeds stored for 0 days have a percentage of germination of 96%, seeds stored for 10 years 85.35% and seeds stored for 25 years have a germination capacity of 6%. Seeds will germinate if storage has passed a period of time but can also with the help of light and gibberellins (GA) during imbibisi. Absciscic acid (ABA) can inhibit endosperm rupture but not with testa (Leubner-Metzger et al., 1995).

Table 2. Percentage of germination and maximal growth potential of tobacco seeds in seed germination various media

Variety	Treatment Seed germination media	Germination(%)	maximal growth potential
Kasturi 2	<i>Straw paper</i>	69,8 ^c	84,5 ^b
	<i>Cotton</i>	52,8 ^d	75,5 ^d
	<i>Tissue towel</i>	68,5 ^c	82,3 ^{bc}
	<i>Paper board</i>	70,3 ^c	86,0 ^b
	<i>Newspaper</i>	67,5 ^c	76,8 ^{cd}
Bojonegoro 1	<i>Straw paper</i>	23,8 ^e	24,0 ^e
	<i>Cotton</i>	24,3 ^e	24,8 ^e
	<i>Tissue towel</i>	27,5 ^e	27,8 ^e
	<i>Paper board</i>	24,5 ^e	24,5 ^e
	<i>Newspaper</i>	25,0 ^e	25,0 ^e
Kemloko 3	<i>Straw paper</i>	96,3 ^a	97,3 ^a
	<i>Cotton</i>	76,0 ^{bc}	82,3 ^{bc}
	<i>Tissue towel</i>	97,5 ^a	97,5 ^a
	<i>Paper board</i>	98,0 ^a	98,0 ^a
	<i>Newspaper</i>	82,8 ^b	82,8 ^{bc}
	Coefficient of variation (%)	8,94	5,92

Note: The numbers followed by the same letters in the same columns are not significantly different in the DMRT test $\alpha 0,05$

The use of paper substrates / media used for germination test with paperboard, tissues and straws is quite in accordance with the character of tobacco seeds. The use of these media makes it easy for seed sprouts to grow upright and sturdy and does not inhibit root growth. The results of Agustin and Lestari (2016) research show that tissue towels are quite effective for testing lettuce and onion seeds. The percentage of germination of rice seeds germinated with straw paper

was significantly higher than CD paper (Nugraha, U.S., Rasam, Wahyuni, S., 2003). In addition to the use of media, the germination method with the UDK method is suitable for testing the viability of tobacco seeds. According to Widadjati, E., Muniarti, E., Palupi, E.R., Kartika, T., Suhartanto, M.R., Qadir, A., (2014) that germination testing for small seeds can use the paper test method (UDK). The UDK method is a germination test method that uses a petri dish coated with three sheets of paper media and the seeds are placed on paper. Test methods with substrate as a media, faster and easier to assess the important structures of sprouts and can be easily standardized. Test methods can be carried out to obtain germination and growing strength, this depends on the environmental conditions of seed testing

3. Percentage of seedling vigor index and normal seedling dry weight

An increase in seedling vigor index can be associated with an increase in active oxygen metabolism in sprouts. According to Tilaki, G.A.D., Behtari, B., Alizadeh, M.A., Jafari, A.A., (2010) that the sprouts vigor index test can be calculated using the formula (hipokotil length + root length) x germination. The seedling vigor index is also related to the normal seedling dry weight which reflects the weight of biomass material that has accumulated during 14 Day After Planting (DAP). The biomass material is obtained from the process of plant photosynthesis which produces a substrate in the form of carbohydrates for plant growth (Sitompul, 2016). Testing of three tobacco varieties seed using various germination media showed a very significant effect on the percentage vigor index and normal seedling dry weight. Table 3 shows that the Kemloko 3 tobacco variety seeds planted on straw paper and paper tissue media had a high percentage of seedling vigor index (153,3% and 149,8%) and differed significantly from the other treatments. While the seeds of Kemloko 3 variety planted on paperboard germination media showed the best normal seedling dry weight which was 0,0068 g but not significantly different from the media of rice straw (0,0063 g) and tissue paper (0,0061 g).

Table 3. Percentage of seedling vigor index and normal seedling dry weight of tobacco seeds in seed germination various media

Variety	Treatment Seed germination media	Seedling vigor index(%).....	Normal seedling dry weight(g).....
Kasturi 2	Straw paper	90,3 ^c	0,0053 ^{bcd}
	Cotton	41,5 ^e	0,0037 ^{ef}
	Tissue towel	80,0 ^{cd}	0,0045 ^{cde}
	Paper board	71,5 ^d	0,0047 ^{cde}
	Newspaper	82,8 ^{cd}	0,0049 ^{cd}
Bojonegoro 1	Straw paper	25,0 ^f	0,0025 ^{gh}
	Cotton	19,5 ^f	0,0017 ^h
	Tissue towel	29,3 ^{ef}	0,0024 ^{gh}
	Paper board	23,3 ^f	0,0029 ^{fg}
	Newspaper	22,8 ^f	0,0024 ^{gh}
Kemloko 3	Straw paper	153,3 ^a	0,0063 ^{ab}
	Cotton	77,3 ^{cd}	0,0042 ^{de}
	Tissue towel	149,8 ^a	0,0061 ^{ab}
	Paper board	120,8 ^b	0,0068 ^a
	Newspaper	91,8 ^c	0,0056 ^{bc}
Coefficient of variation (%)			16,99

Note: The numbers followed by the same letters in the same columns are not significantly different in the DMRT test $\alpha 0,05$

The percentage of seedling vigor index on tobacco seeds using paper germination media is done by measuring the length of normal sprouts. This parameter shows a good germination stage that is in the presence of strong, upright radicles and have primary and / or secondary roots. While hypocotyl from normal sprouts has the characteristics of upright, sturdy, no injuries, and color white. The cotyledons from normal sprouts are light green, dark green or yellow, fresh looking, no injuries, no contamination from fungi or bacteria, and some cotyledons have bloomed completely. An increase in vigor index was also found in corn and cowpea seeds (Eskandari and Kazemi, 2011), an increase in vigor index was caused by an increase in germination and length of

the sprouts or the length of the sprouts compared to the control (Hanegave, A.S., Hunje, R., Nadaf, H.L., Biradarpatil, N.K., Uppar, D.S., 2011).

The use of germination media suitable and adapted to small types of tobacco seeds can affect seed germination. In addition, germination media must have high porosity, good drainage and aeration (Hardiwinoto, S., Nurjanto, H.H., Nugroho, A.W., Widiyatno, 2011.). The substrate specifications for seed testing are: (1) paper must be porous, allow roots to grow (2) free from molds, bacteria, and toxic substances that can affect germination, (3) remain tenacious / strong for the duration of the test, (4) able to hold enough water during the test, and (5) pH 6.0-7.5. The low ability of newsprint and cotton in testing the viability of tobacco seeds is caused by not being effective enough for seed growth until observations at the last count that is on the 14th day after planting. This is suspected because the cotton media is not dense enough and there is ink attached to the newspaper and can inhibit the growth of seeds. Newspapers have inherent ink and Pb content which has the potential to cause fungus during germination (Agustin and Lestari, 2016); (Azhar, 2014).

E. Conclusion

The Kemloko 3 variety tobacco seeds germinated on paper board, tissue and straw paper have the best percentage of seed vigor and viability. Seed germination media with paper board, tissues and straw paper can be used to test the viability of tobacco seeds because they have a growing percentage of Simultaneous growth (97,5%; 97,5%; 96,3%), growth speed (23,0%; 22, 8%; 21,8%), germination (98,0%; 97,5%; 96,3%), maximum growth potential (98,0%; 97,5%; 97,3%) and normal seedling dry weight (0,0068 g; 0,0063 g; 0,0061 g) are equally good.

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