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PHYSICAL AND CHEMICAL SCARIFICATION ON DORMANCY BREAKING OF ROSARY PEA SEEDS (*ABRUS PRECATORIUS* L.)

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Abstract: *Seeds are part of the plant containing embryo that grows through the germination process. This process involves metabolism occurs in seeds to produce roots and shoots. However, this metabolic process is inhibited by the environment and genetics of the seeds itself. Thus, the seeds experience dormancy and fail to grow. Dormancy can be broken with help of physical and chemical scarification to accelerate seed germination. The research aim was to determine the physical and chemical scarification seed dormancy breaking in increasing the germination rosary pea seeds (Abrus precatorius L.). The research method used was experimental randomized block design using 4 treatment groups, namely cracked (F1), sanded (F2), and soaked in 50%* H_2SO_4 *solution for 15 minutes (K1) and 30 minutes (K2) and the group control with water. The viability germination, germination rate (GER), vigor index (VI), simultaneous growth (SG) normal sprouts on day 6, and growth rate (GOR) were observed for two weeks. The results obtained that immersion in* H_2SO_4 *50% solution for 30 minutes and cracking could break the dormancy of rosary pea seeds and increase germination with higher viability of germination, GER, VI, SG, and GOR than immersion in 50%* H_2SO_4 *solution for 15 minutes and sanding.*

PENDAHULUAN

Germination is the process of reactivating the growth of the embryonic axis in the seed which stops forming seeds (seedling). In very young embryos, the cells are almost the same shape and size and have not been differentiated. These cells divide repeatedly and undergo growth, development, and eventually, organs, such as roots, stems, and leaves will appear [2,7,29,31].

This germination involves metabolic processes that occur in the seed to produce the radicle and plumule (shoot). However, this process can be inhibited by seed genetics or the environment called dormancy. Dormancy is the growth and metabolism that is buried or stopped, caused by an unfavorable environment or factors from within the seed itself. A dormant tissue can fail to grow, even under ideal conditions [6,12,32,33]. The ability of seeds to delay germination until the right time and place is an important survival mechanism in plants. Seed dormancy is passed down genetically as and way for plants to survive and adapt to their environment. The intensity of dormancy is influenced by the environment during seed development [6,16,34].

One way to accelerate germination with the help of treatments to break seed dormancy is scarification. Scarification is one of the pretreatment efforts or initial treatment of seeds aimed at breaking dormancy and accelerating seed germination [3,12,15]. The scarification technique on various types of seeds must be adjusted to the level of seed dormancy [34]. This technique, namely physical and chemical treatment. Physical treatment of the testa by stabbing, scraping, breaking, and filing with the help of a knife, needle, file, and rubbing paper is a very effective way to overcome seed dormancy [4,13,17].

The entire surface of the testa can be used as a water absorption point. In legumes, the palisade cell layer of the testa absorbs water and the softening process spreads from this point to the entire testa surface [22,25]. Scarification is effective on the testa surface. However, the micropylar area contains a radicle which should avoid. Damage to this area can impair seed germination. Meanwhile, damage to the cotyledons will not affect germination [1,20,30].

Chemical treatment with chemicals can be done to break dormancy in seeds. The goal is to make the testa easier for water to enter at the time of imbibition. Strong acid solutions such as sulfuric acid with concentrated concentrations can make the testa soft, so it can be entered by water easily [9,17,24,28]. An acid solution in this study using sulfuric acid (H_2SO_4). This acid solution causes damage to the testa and can be applied to both legumes and non-legumes [10,19]. However, this method is not suitable for seeds that are easily permeable because the acid will damage the seed embryo. Therefore, the purpose of this research was to determine the physical and chemical scarification of seed dormancy breaking in increasing the germination of rosary pea seeds (*Abrus precatorius* L.).

METODE PENELITIAN

This research method is an experimental randomized block design using 4 treatment groups, namely cracked (F1), sanded (F2), and soaked in 50% H_2SO_4 solution for 15 minutes (K1) and 30 minutes (K2), and the control group was given water. Each treatment group was carried out in two replications so that 10 experimental units were obtained with each unit containing 10 seeds. The tools and materials used were Petri dishes, iron sandpaper, tissue, cotton, water, rosary pea seeds (*Abrus precatorius* L.), 50% H_2SO_4 solution, 2% fungicide solution, and 10% Clorox solution. In this research, the seeds were sterilized with a 2% fungicide solution for 10 minutes and washed with sterile water. The seeds were re-sterilized with 10% Clorox solution for 5 minutes. After that, dry with a tissue. Seeds were given physical (F1 and F2) and chemical (K1 and K2) treatments. Seeds are planted in Petri dishes that have been given cotton and water. The viability of germination, germination rate (GER), vigor index (VI), simultaneous growth (SG) on normal sprouts on day 6, and growth rate (GOR) for two weeks was observed with the following formula:

Viability Germination

$$\text{Viability} = \frac{\sum \text{Seeds germinate}}{\sum \text{Germinated seeds}} \times 100\%$$

Germination Rate (GER)

$$GER = \frac{\sum KNA + \sum KNB}{\sum \text{Germinated seeds}} \times 100\%$$

Where:
GER : Seeds germination rate
KNA : Normal sprouts on the first day (6^{th} day)
KNB : Normal sprouts on the last day of observation (14^{th} day)

Vigor index (VI)

$$VI = \frac{\sum KN-n}{\sum \text{Seeds planted on the day}-n} \times 100\%$$

Where:
VI : Vigor index
KN : Normal sprouts

Simultaneous Growth (SG)

$$SG = \frac{\sum KNA}{\sum \text{Germinated seeds}} \times 100\%$$

Where:
SG : Simultaneous growth
KNA : Normal sprouts on the first day (6^{th} day)

Growth Rate (GOR)

$$GOR = \frac{\sum \%KN-n}{\sum t-n} \times 100\%$$

Where:
GOR : Growth rate
%KN : Percentage of normal sprouts
t : Observation time of day-n

HASIL DAN PEMBAHASAN

Breaking dormancy of rosary pea seeds (*Abrus precatorius* L.) in table 1 shows that treatment K2 had higher average germination, germination viability, GER, VI, and GOR than F1, F2, and K1, except KST. Because SG has the same percentage as F1. Chemical scarification was more effective in the germination of rosary pea seeds (*Abrus precatorius* L.) than physically. Due to physical scarification during germination, some seeds only rapture the testa but do not remove the radicle. This happens because when rubbed on the embryo of the seed. Normal germinating seeds show the presence of a radicle. The most important factor in this germination is imbibition. Because of the entry of water into the seeds, it can stimulate the amylase enzyme to convert starch into sugar which will be translocated to the radicle and plumule [5,8,14].

Table 1. Germination, viability, GER, VI, SG, and GOR of rosary pea seeds on physical and chemical scarification

Treatment	Germination (Mean±SE)	Viability germinates	GER	VI	SG	GOR
F1	12,2±1,9	8,6%	0,07%	0,4%	0,05%	1%
F2	8,2±1,7	5,8%	0,05%	0,3%	0,01%	0,6%
K1	11,4±2,0	8%	0,08%	0,4%	0,03%	0,9%
K2	15,6±2,3	11%	0,1%	0,6%	0,05%	1,4%
Kontrol	0±0	0%	0%	0%	0%	0%

F1: Cracked, F2: Sanded, K1: H_2SO_4 50% for 15 minutes, K2: H_2SO_4 50% for 30 minutes, GER: Germination rate, VI: Vigor Index, SG: Simultaneous Growth, GOR: Growth Rate

The histogram shows that chemical scarification (K1 and K2) was better in increasing the germination of rosary pea seeds (*Abrus precatorius* L.) than physical scarification (F1 and F2) which can be seen in Figure 1. Rosary pea seeds that were soaked in H_2SO_4 at different times can affect germination (Saila *et al*., 2016). Where seeds with hard testa can germinate. Seeds with a soaking time of 30 minutes showed the highest percentage of germinating seeds of 32.66%. While the immersion for 10 minutes was 23.33% [23]. Because the testa is quite soft and can absorb water optimally, thus supporting germination. Seeds soaked for 30 minutes were able to germinate well which can be seen in Figure 2d.

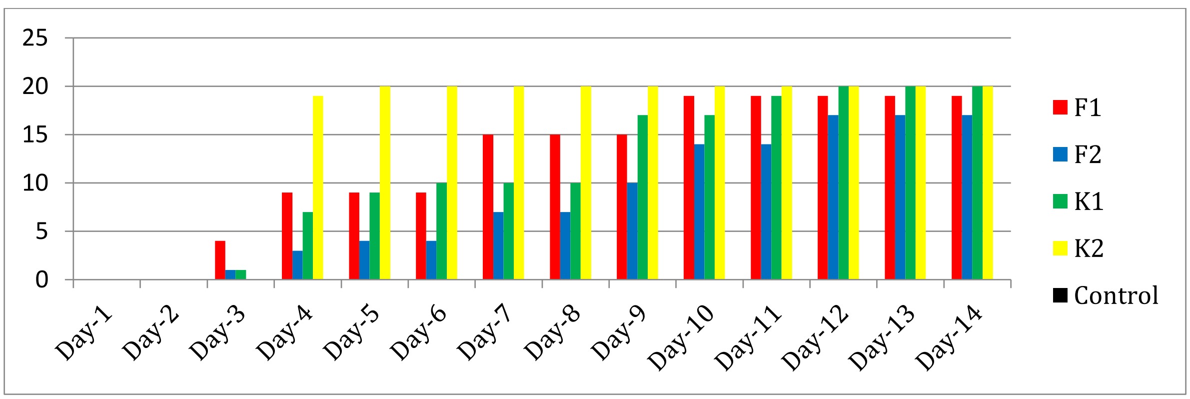

Figure 1. Histogram of rosary pea seed germination by physical scarification (cracked (F1) and sanded (F2)) and chemically (H_2SO_4 50% for 15 minutes (K1) and 30 minutes (K2))

Chemical scarification with H_2SO_4 immersion to soften the hard testa with enough time to absorb it into the rosary pea seeds (*Abrus precatorius* L.), so that the dormancy period is broken. The H_2SO_4 solution is acidic, very hard, has a pungent smell, and can reduce the layer of material quickly [19,23]. Soaking the seeds with a concentration of 10% H_2SO_4 solution and soaking time of 10 minutes, 20 minutes, and 30 minutes. The highest seed germination was obtained by soaking for 30 minutes with the percentage of germination reaching 88% [26].

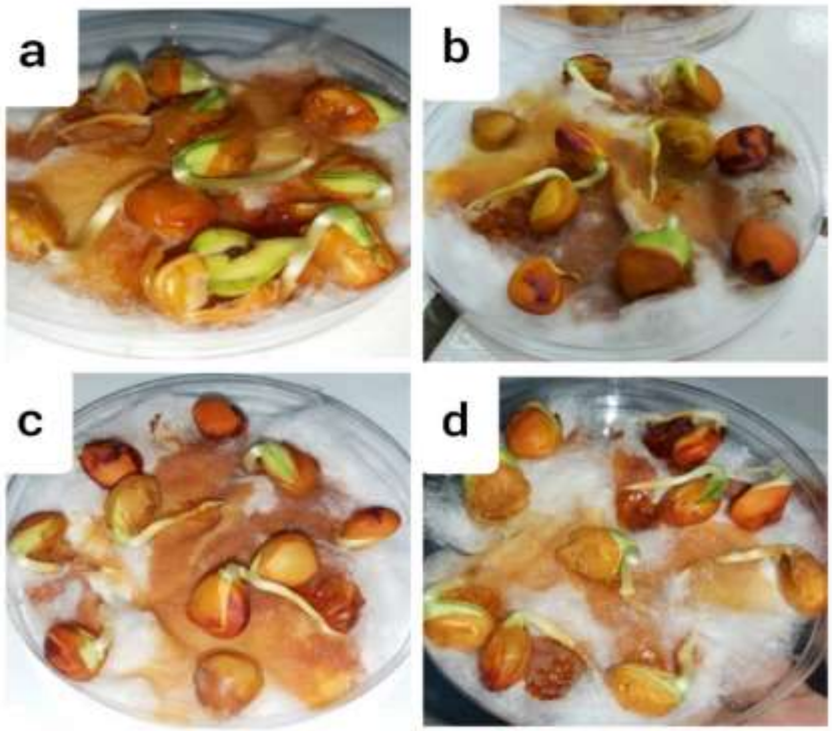

Figure 2. Breaking dormancy by a) cracking, b) sanding, and soaking in 50% H_2SO_4 for c) 15 minutes and d) 30 minutes

Physical scarification by cracking and sanding can break the dormancy period and facilitate imbibition so that the seeds can germinate which can be seen in Figures 2a and 2b. Scarification by cracking can increase seed germination compared to sanding which can be seen in table 1 and figure 1. This physical scarification differs with scarification by sanding can increase germination, speed of germination, and simultaneous germination. Sanding in the center of the seed can produce the highest viability of 47% [21]. Because the absorption surface is wider, thus facilitating the imbibition process into the embryo. Meanwhile, the edge of the absorption surface is relatively narrower and this condition causes less water to be absorbed into the embryo [11,27].

KESIMPULAN

Physical and chemical scarification can break the dormancy of rosary pea (*Abrus precatorius* L.) seeds. However, chemical scarification had higher germination viability, GER, VI, SG, and GOR than physical scarification. Chemical scarification can also increase the germination of rosary pea (*Abrus precatorius* L.) seeds better than physical scarification. Physical and chemical scarification is expected to increase dormancy breaking in seeds with tough testa. Thus, it is easy to germinate in increasing the production of hard-shelled plants.

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HALAMAN INI SENGAJA DIKOSONGKAN