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Improvement of Quality TSS Onion Seeds Red (*Allium ascalonicum* L.) with Lime as a Material *Coating*

Kurnia Adisya Septyaputri[1], Sutini[1], Makhziah[1,*]

Abstract

The availability of shallot seeds is a major problem in shallot cultivation; therefore, True Shallot Seed is used to overcome this problem. To make the use of TSS seeds more optimal, their germination and growth strength must be increased, one of which is by providing seed coating treatment to TSS seeds. Seed coating aims to improve and maintain seed quality, protect seeds from pathogen attacks and unfavorable environmental conditions, and support plant growth. The purpose of this study was to improve the quality of shallot TSS seeds. The experiment was conducted using a completely randomized design method with six levels and three replications. Seed coating treatments included (1) No Treatment (Control); (2) Dolomites; (2) Gypsum; (3) Quicklime; (4) Talc; (5) Pumice. The results showed that the best treatment was Gypsum, which increased the parameters of maximum growth potential, germination power, and growth synchrony. Coating seeds with Gypsum gave better results than seeds without coating treatment. The use of Gypsum as a coating material can be used as a simple and inexpensive alternative technology to improve the quality of shallot TSS seeds, making it suitable for adoption on a production and cultivation scale.

Keywords: Growing Power, Growing Strength, Gypsum, Viability, Vigor

1. Introduction

Shallots are one of the food commodities targeted by Indonesia to become the world's food barn by 2045. However, there are several fundamental challenges facing this goal, including its productivity is still low. Shallots can be propagated using seeds and bulbs (Mudhalifah & Pribadi, 2025). However, the use of bulb seeds is considered inefficient due to the often limited availability of quality bulb seeds. One way to address the issue of bulb seed availability and increase shallot productivity is to use *True Shallot Seed*. To optimize the use of TSS seeds of the Biru Lancor variety, their germination and vigor must be increased, as TSS seeds have a relatively low germination rate. To improve the physiological quality of TSS seeds, special seed treatment is required. One such treatment is seed coating. This technique involves using specific materials to coat the seeds, aiming to improve seed quality, protect them from pathogens and adverse environmental conditions, while also aiding plant growth. Coating materials generally include adhesives and additives (Perdana *et al*., 2023).

The seed coating process aims to improve the quality and support the growth of TSS seeds with low viability. Seed coating also serves to protect the seeds from potential physical damage. Some types of materials commonly used for coating include dolomite, Gypsum, quicklime, talc, and pumice. These materials can absorb moisture around the seed, resulting in a more balanced humidity and water vapor environment. Stable seed moisture content allows for the maintenance of viability and vigor, while reducing the rate of deterioration. Furthermore, a balanced moisture content can suppress the growth of pathogens that can inhibit seed germination (Jasmi, 2017). Some alkaline materials can neutralize the pH around the seed, thereby inhibiting pathogen growth.

Research on *seed coating treatment* on shallot TSS seeds has been conducted by (Maulana *et al*., 2022) using CMC, humic acid, and Gypsum as *coating materials;* the study only used one type of additive, namely Gypsum. This study used several types of lime as additives to obtain a

*Correspondence: makhziah.agro@upnjatim.ac.id
1) Universitas Pembangunan Nasional "Veteran" Jawa Timur - Jl Rungkut Madya No. 1, Gn. Anyar, Kota Surabaya, Jawa Timur, Indonesia

type of lime that can improve the quality of shallot TSS seeds. The selection of the appropriate adhesive composition and additives in seed coating has the potential to have a positive impact on the quality and growth of TSS seeds. This study aims to obtain a type of lime that can improve the quality of shallot TSS seeds.

2. Material and Methods

2.1. Time and Place

This research was conducted from February to April 2025, taking place in the Laboratory, Greenhouse, and land owned by the Technical Implementation Unit for Rice and Secondary Crops Seed Development in Randuagung Village, Singosari District, Malang Regency, East Java, located at an altitude of 487 meters above sea level. This location is at coordinates 7 ° south latitude and 112 ° east longitude.

2.2. Research Methods

The experiment was conducted using a Completely Randomized Design (CRD) with a single factor with 6 levels, namely the type of lime as a *coating material* consisting of (1) No Treatment (Control), (2) Dolomite 32 g, (3) Gypsum 32 g, (4) Quicklime 32 g, (5) Talc 32 g, (6) Pumice 32 g. Each treatment was repeated three times. [Note: Each treatment was given adhesive material (CMC 1.5% + Humic Acid 0.6% + Liquid Smoke 0.5%)].

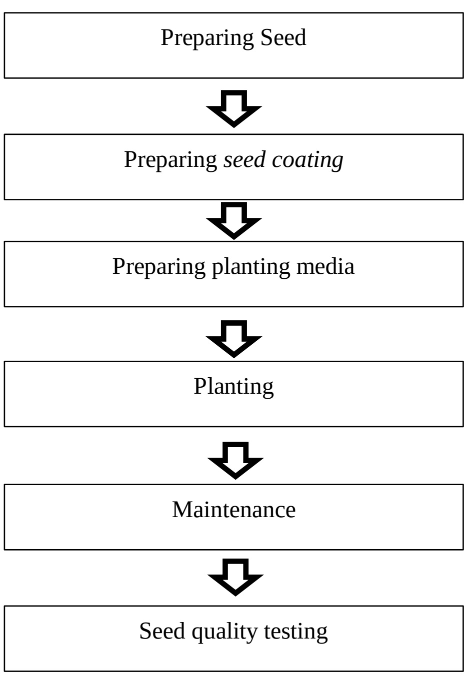

Figure 1. Research flow diagram

3. Results and Discussion

The application of various types of lime during the seed coating process *significantly* affected most of the quality parameters of shallot TSS seeds. Significantly affected parameters included water content, maximum growth potential, germination rate, and growth synchrony. However, these treatments did not significantly affect the vigor index.

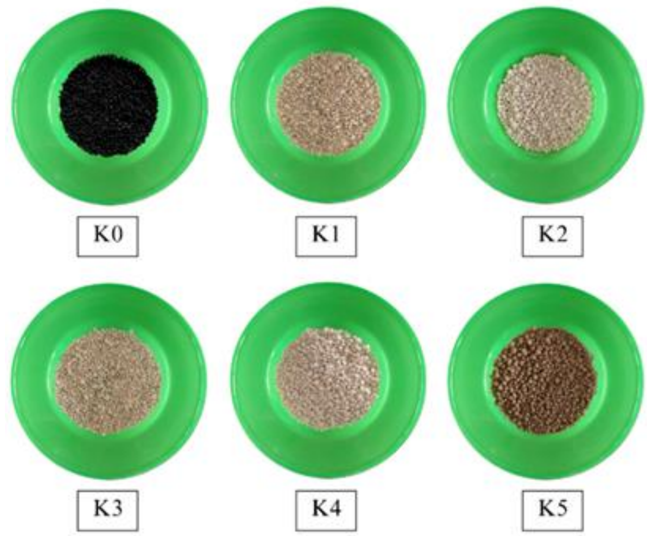

Figure 2. Visualization of TSS Red Onion Seeds from *Coating* Treatment (K_0: no treatment, K_1: dolomite, $K_{2:\ \text{dolomite)}}$: Gypsum, K_3: quicklime, K_4: talc, K_5: pumice)

Figure 2 shows the visual appearance of *coated seeds*. Uncoated TSS seeds *are* black, irregularly flat, and the smallest in size. Dolomite-treated seeds are grayish white, with a layer that is not too thick and a slightly rough surface. Gypsum-treated seeds are white, smooth-surfaced, and slightly thicker than Dolomite. Quicklime-treated seeds are grayish white-brown, with a layer that is not too thick and a slightly rough surface. Talc-treated seeds are the largest, pure white, with a very thick layer and a smooth surface. Pumice-treated seeds are light brown, with a slightly rough and thick layer.

All coated seeds showed higher water content compared to control seeds (without *coating*). However, the water content of both coated and control seeds *did not* exceed the maximum limit stipulated in the Decree of the Minister of Agriculture Number: 131/Kpts/SR.130/D/11/2015, which is 8.0% (Agriculture, 2015). This finding indicates that the *coating treatment* does not reduce the quality of the seeds in terms of water content and still meets the certification standards for shallot seeds.

The only significant difference was found in uncoated seeds. Uncoated seeds had the lowest water content compared to coated seeds. The lack of difference in coated seeds *may* be due to the similar effect of the type of lime used on water content, due to the similar hygroscopic and absorbent properties of the materials used.

The moisture content of TSS seeds in each treatment ranged from 5.90% to 6.13%. The seeds with the highest moisture content were those treated with Dolomite, Gypsum, and Talc, with a moisture content of 6.13%. Meanwhile, the lowest moisture content was found in uncoated seeds, *at 5.9%. The coating* content and thickness of the seed layer can affect the moisture content of the seeds. Increasing the thickness of the *coating layer* tends to result in a higher seed moisture content. The moisture content of TSS seeds of the Trisula variety in a study (Maulana *et al* ., 2022) showed that seeds treated with *coating* (1.5% CMC + 0.6% Humic Acid + 20 g Gypsum) had an average moisture content of 7.00%. Differences in moisture content values may be due to differences in seed storage environments.

Table 1. Average Water Content of TSS Seeds

***Coating* Material**	**Water content (%)**
No Treatment	5.90 ± 0.06 a
Dolomite	6.13 ± 0.03 b
Gypsum	6.13 ± 0.03 b
Calcium oxide	6.07 ± 0.03 ab
Talk	6.13 ± 0.07 b
Pumice	6.10 ± 0.06 b
BNJ 5%	0.22

Seeds stored in dry places will lose water content due to evaporation. Seeds are hygroscopic, so if stored in a place with low humidity, the seeds will release water and their water content will decrease (Fachruri *et al.*, 2019). Seeds without *coating treatment* have a lower water content than coated seeds. This result can occur due to the previous storage process. The water content of coated seeds *tends* to increase because the coating material absorbs moisture. The calcium (Ca) and silicon (Si) elements in the *coating material* can absorb and release water, thus affecting the water content of the seeds (Maulana *et al*., 2022). Although talc does not contain Ca or Si, it can coat the seeds thickly, thereby increasing the water content of the seeds. Talc has the property of easily sticking because it has high adhesive power, so that talc can coat the seeds with a thick layer (Rismayang, 2022).

Low water content is important for seed storage because it helps maintain vigor and viability. The lower the water content, the longer the seeds can survive. This condition is closely related to the activity of enzymes that support the germination process. However, excessive water deficiency can cause seeds to harden, disrupt imbibition, and risk embryo death. Seed water content must be controlled according to quality criteria. If the water content is too low, the enzymes for germination are inactive. Conversely, excessive water content can damage the seed embryo (Arif & Illahi, 2018). Research results show that coated seeds have *a* higher water content but are still safe. In contrast, uncoated seeds *with* very low water content can potentially inhibit germination.

Table 2. Average Maximum Growth Potential and Germination Power

***Coating* Material**	**PTM (%)**	**DB (%)**
No Treatment	85.33 ± 8.74 bcd	84.67 ± 9.40 bc
Dolomite	87.67 ± 0.33 cd	86.67 ± 0.33 c
Gypsum	91.00 ± 2.52 d	91.00 ± 2.52 c
Calcium oxide	69.33 ± 7.75 abc	69.33 ± 7.75 abc
Talk	60.67 ± 3.18 a	60.33 ± 3.18 a
Pumice	65.00 ± 5.03 ab	63.67 ± 5.24 ab
BNJ 5%	24.60	25.55

Seed quality is positively correlated with viability and vigor. Superior-quality seeds have optimal viability and vigor. Seed viability refers to the seed's capacity to grow and develop physiologically normally under favorable environmental conditions (Sari, 2021). Viability parameters include maximum growth potential and seed germination.

Statistical results show that the type of lime used as a *coating* significantly affects the maximum growth potential of shallot TSS seeds. *Coating treatments* do not always produce a higher maximum growth potential than the control. The maximum growth potential of control seeds was 85.33%. Seeds treated with dolomite and Gypsum had a maximum growth potential of 87.67% and 91.00%, respectively. However, the quicklime, talc, and pumice treatments showed lower maximum growth potentials, namely 69.33%, 60.67%, and 65%.

The type of lime used as a *coating material* significantly affected the germination of shallot TSS seeds. Gypsum treatment provided the highest germination rate, at 91.00%, higher than the control at 84.67%. This result exceeded the minimum limit of 70% set by the Decree of the Minister of Agriculture Number: 131/Kpts/SR.130/D/11/2015 (Agriculture, 2015). A high germination rate indicates the seeds' ability to germinate well.

Good seed viability is evident from the high maximum growth potential and germination rate. Gypsum treatment showed the best results, with maximum growth potential and germination rate reaching 91.00%. The similarity in values for these two parameters indicates the absence of abnormal seeds in the gypsum treatment. In a study (Maulana *et al*., 2022), germination results also showed high results, namely 92.50%. This result was obtained with the *coating treatment* (1.5% CMC + 0.6% Humic Acid + 20 g Gypsum). Similar results can be obtained because the *coating materials* used are similar.

High viability indicates sufficient nutrient reserves in the endosperm, providing energy for germination. Using the right *coating material helps maintain the seed's nutrient reserves. Gypsum is the best coating material* for shallot TSS seed viability because it contains calcium (Ca), which is essential for germination (Rismayang, 2022). Gypsum has the highest calcium (Ca) content compared to other lime materials used.

Table 3. Average Vigor Index and Growth Simultaneity

***Coating* Material**	**IV (%)**	**KsT (%)**
No Treatment	72.67 ± 9.87	80.33 ± 12.33 abc
Dolomite	65.00 ± 1.73	85.00 ± 1.00 bc
Gypsum	67.33 ± 10.27	90.00 ± 2.00 c
Calcium oxide	58.67 ± 6.98	65.00 ± 8.02 abc
Talk	37.00 ± 8.66	53.67 ± 7.13 a
Pumice	48.67 ± 4.98	60.33 ± 6.17 ab
BNJ 5%	tn.	32.44

Seed vigor is related to normal sprouts with good shoot growth and roots that can absorb nutrients effectively (Sari et al., 2025). Seed vigor parameters include the vigor index and growth synchrony. The type of lime used as a *coating material* did not significantly affect the vigor index of shallot TSS seeds. The highest average vigor index was obtained in control seeds (without *coating*). This result indicates that lime as a coating has not been able to increase the vigor index. The low vigor index value is caused by the presence of *the coating material that prevents the emergence of the radicle. Uncoated* seeds germinate more easily (Maulana *et al*., 2022).

The highest growth simultaneity was obtained from the Gypsum treatment with a value of 90.00%, higher than the control, which was 80.33%. This value is considered high, exceeding the ideal range of 40 to 70%. The high growth simultaneity value reflects superior seed vigor, where the seed group can germinate synchronously and shows optimal growth strength (Megasari *et al*., 2024). The vigor index and growth simultaneity values in the study (Maulana *et al* ., 2022) showed figures of 78.00% and 84.25%. The vigor index value of seeds with *coating treatment* in this study was lower than in previous studies, but had a higher growth simultaneity value in the treatment with the highest yield (gypsum treatment), which was 90.00%.

The low maximum growth potential, germination power, vigor index, growth rate, and growth synchrony in quicklime, talc, and pumice are caused by inappropriate conditions. Talc forms a thick layer that can inhibit germination (Rismayang, 2022). Pumice is rough (abrasive) and can damage the surface of the seed during coating (Dewi *et al*., 2025).

4. Conclusion

Coating can improve the quality of shallot TSS seeds and project superior results in terms of maximum growth potential, germination rate, and growth synchrony. Seeds *coated with* Gypsum yield better results than uncoated seeds. The use of Gypsum as a *coating material* can be a simple and inexpensive alternative technology to improve the quality of shallot TSS seeds, making it feasible for adoption on a production and cultivation scale.

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