Seed Coating Application on the Quality of Rice Seeds, Shallot TSS Seeds, Red Chili Seeds, and Cucumber Seeds

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Abstract. Low production of rice and horticultural crops can be caused by the limited supply of high quality seeds. The quality can be seen from the moisture content, viability value and seed vigor. One of the efforts that can be made to maintain or improve seed quality is seed coating technology. This study aims to determine the effect of seed coating in maintaining and improving the quality of rice seeds, TSS merang onion seeds, red chili seeds, and cucumber seeds. The research was conducted from November 2021 to January 2022 at the Technical Implementation Unit (UPT) of Rice and Palawija Seed Development Singosari, Malang, East Java. The experiment used a completely randomized design (CRD) with a single factor, namely the type of seed coating material. The seed coating materials for rice seeds were CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Gypsum 32 g, CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Dolomite 32 g, and CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Kapur Tohor 32 g. While the seed coating materials for TSS shallot seeds, red chili seeds, and cucumber seeds were CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g. The results showed that the composition of the coating material CMC 1.5% + Liquid smoke 0.5% + $CaCO_3$ 8 g + Gypsum 32 g produced the highest quality of rice seeds, while the coating material CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g could improve the quality of TSS onion and cucumber seeds.

Keywords: Seed · Seed Coating · Moisture Content · Viability · Vigor

1 Introduction

Food crops and horticulture are commodities that have good development prospects with high economic value and are much needed by the community. This causes most farmers in Indonesia to choose to cultivate food crops, especially rice and horticultural crops such as shallots, red chilies, and cucumbers. Horticultural commodities are divided into vegetable crops, fruit crops, medicinal plants, and ornamental plants. Currently, rice and horticultural crops are one of the fastest growing agricultural sectors in Indonesia.

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Production of rice and horticultural crops is still low. This is due to the low provision of high quality seeds. Seed quality includes genetic quality, physiological quality, and physical quality. Physical quality can be indicated by seed moisture content. At physiological maturity, the seeds have the highest quality, i.e. the seed moisture content has decreased to below 20% so that the seed dry weight is maximum and the seed viability is also maximum. The physiological quality of seeds can be indicated by the viability and vigor of the seeds [1].

Seeds during storage can experience deterioration. Seed deterioration causes overall changes in the seed and results in a decrease in seed quality and causes plant growth in the field to be not optimal. Therefore, seed quality must be maintained or improved so that plants can grow well. One of the efforts that can be made to maintain or improve seed quality is seed coating technology. Seed coating is done by wrapping seeds using certain materials such as pesticides, ZPT nutrients, antioxidants, additives, and other components to maintain seed viability. These conditions are needed so that the seeds are not damaged and are able to germinate after the storage period [2]· Seed coating is done to facilitate sowing with uniform spacing and protect the seeds because the coating serves as a carrier for plant protection [3].

Appropriate adhesives are required for seed coating application and the coating material must be compatible with the seed. Seed coating materials that are often used are Carboxymethyl Cellulose (CMC) and also additives. CMC at a concentration of 0.5–3% is able to stabilize and homogenize the suspension with good viscosity for seed coating materials [4]. The addition of additives such as gypsum, kaptan, dolomite, and talc contain Ca, Mg, and Si which are very instrumental in balancing moisture and water vapor around the seed environment [5]. In addition to these materials, liquid smoke and humic acid also contain phenolic compounds as antioxidants because they can slow down seed deterioration. Increased seed germination percentage at liquid smoke concentrations of up to 0.5% and humic acid concentrations of 0.6% [6] and 0.6% humic acid concentration showed that the seeds were able to maintain their quality [7]. Several types and formulas of seed coating materials have been applied and have specific effects on each seed [8] stated that seed coating on rice seeds using CMC 1.5% + gypsum has a good effect on the quality of rice seeds with a germination rate of 84.5%.

This study aims to determine the effect of seed coating in maintaining and improving the quality of rice seeds, TSS of leek, red chili, and cucumber.

2 Research Methods

The research was conducted at the UPT for Rice and Palawija Seed Development in Randuagung Village, Singosari District, Malang Regency, East Java. The research implementation time began in November 2021 and ended in January 2022. The tools and materials used in this research are rotary coater machine, petri dish, measuring cup, Draminski Gmm moisture meter, analytical balance, sieve, germination tub, rice seeds, shallot TSS seeds, red chili seeds, cucumber seeds, CMC, $CaCO_3$, gypsum, dolomite, quicklime, liquid smoke, humic acid, distilled water, and sterile sand. This study used a completely randomized design (CRD) with a single factor, namely the type of seed coating material. Seed coating materials for rice seeds were CMC 1.5% + Liquid Smoke

0.5% + $CaCO_3$ 8 g + Gypsum 32 g, CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Dolomite 32 g, and CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Lime Tohor 32 g. Meanwhile, the seed coating materials for TSS shallot seeds, red chili seeds, and cucumber seeds are CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g.

The seeds used were rice seeds of the Inpari 42 Agritan GSR variety, TSS shallot seeds of the Trisula variety, red chili seeds of the Dori F1 variety, and cucumber seeds of the Green Rocket variety. Before being coated with seed coating material, the seeds were identified and selected. The seed coating process was carried out according to [9]. Seed coating begins with the preparation of adhesive material in the form of CMC 1.5%. The adhesive material for rice seeds was made by dissolving 1.5 g of CMC in 100 ml of distilled water to which 0.5 ml of liquid smoke had been added. As for TSS onion seeds, red chili seeds, and cucumber seeds, 1.5 g of CMC was dissolved in 100 ml of distilled water to which 0.6 ml of humic acid was added. Seed coating materials were weighed according to the treatment. Rice seeds were weighed as many as 820 grains and TSS shallot seeds, red chili seeds, and cucumber seeds as many as 400 grains for each experimental unit. The seeds were put into a rotary coater machine and sprayed with adhesive material five times evenly. On rice seeds, the first layer of seed coating material in the form of 8 g of $CaCO_3$ was added to the rotary coater machine little by little until the entire seed surface was coated. The second layer of material (additive) was added little by little until the seeds were coated. Meanwhile, TSS shallot seeds, red chili seeds, and cucumber seeds were directly given additives in the form of gypsum (no $CaCO_3$). The seed coating process in a rotary coater machine is carried out at a speed of 35 rpm for 20 min. The coated seeds were then filtered and dried until the moisture content was in accordance with the Indonesian National Standard (SNI).

The test was conducted using sterile sand substrate with a neutral pH in the germination tub. The sand substrate was chosen because it can support seed germination better and as a substitute for seedling media before the seedlings are transferred to polybags. Each germination tub was filled with 100 seeds. Maintenance was carried out every day by watering to keep the sand moist. Seed quality testing included determination of moisture content (%), seed germination (%), seed vigor index (%), growth speed (%/ethmal), and growth uniformity (%). The data obtained were then analyzed using a completely randomized design (CRD) to determine the effect of treatment. If the results of the analysis have a significant effect, it will be further tested using Duncan's Multiple Range Test (DMRT) at the 5% level.

3 Result and Discussion

3.1 Water Content (%)

The results of the analysis of variance showed that the seed coating treatment significantly affected the moisture content of rice seeds, shallot TSS seeds, red chili seeds, and cucumber seeds. The moisture content of rice seeds is in accordance with SNI Standard 01-6233.2-2003 which states that one of the seed quality requirements is a maximum moisture content of 13.00%. A decrease in seed moisture content can reduce the respiration rate of seeds. The lower the seed moisture content, the lower the respiration rate. So the seeds can be stored longer because the rate of deterioration is slow. However,

Table 1. Average Moisture Content of Rice Seeds, Red Onion TSS Seeds, Red Chili Seeds, and Cucumber Seed Coating Results.

Seed Coating Materials	KA (%)
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Gypsum 32 g	6,50b
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Dolomite 32 g	6,50b
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Lime Tohor 32 g	6,50b
Red Onion TSS Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	7,00a
Red Chili Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	7,02a

Notes: Numbers accompanied by the same letter in the same column show no significant difference in the 5% DMRT test.

moisture content that is too low can also cause the seeds to become hard, so that when germinated the seeds cannot imbibe and can cause embryonic death. The increase and decrease in seed moisture content is related to the activity of enzymes that play a role in the process of sprout growth [10] states that enzymes are inactive in the first water fraction area or primary bound water (ATP) and enzyme activity begins to occur at the beginning of the second water fraction or secondary bound water (ATS). So that the more the activity increases, the higher the level of water content (Table 1).

The coated red chili seeds have the highest average moisture content of 7.02%. Meanwhile, TSS shallot seeds and cucumber seeds showed an average value of moisture content in accordance with the quality standards set by the Food and Horticultural Plant Seed Quality Testing Development Center (2015) of 7.00%. Seeds with low moisture content are able to maintain their viability. This is related to the activity of enzymes that play a role in the germination process, according to [11] which states that enzymes are inactive in the first water fraction area or primary bound water (ATP), and enzyme activity begins to occur at the beginning of the second water fraction or secondary bound water (ATS), which increases its activity when the water content level is high.

3.2 Germination

The results of the analysis of variance showed that the seed coating treatment had a significant effect on the germination of rice seeds, shallot TSS seeds, red chili seeds, and cucumber seeds. Quality seeds are seeds with high viability. Seed viability can be known from the value of germination. Seeds that grow normally in the germination test can be a benchmark in determining the ability of seeds to grow and germinate in the field. The average germination rate in all treatments was more than 80% and even reached 100%. The highest average germination power was obtained in rice seeds from seed coating CMC 1.5% + liquid smoke 0.5% + $CaCO_3$ 8 g + gypsum 32 g with a consecutive value of 100.00%. This shows that the seed coating material can increase germination. The results are in line with [12] which stated that the seed coating treatment produces a higher viability value than without seed coating. This is because seeds without seed coating treatment do not have protection on the surface of the seeds (Table 2).

Table 2. Average Germination of Rice Seeds, Red Onion TSS Seeds, Chili Seeds Red, and Coated Cucumber Seeds.

Seed Coating Materials	DB (%)
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Gypsum 32 g	100,00a
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Dolomite 32 g	98,50a
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Lime Tohor 32 g	99,00a
Red Onion TSS Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	92,50b
Red Chili Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	84,25c

Notes: Numbers accompanied by the same letter in the same column show no significant difference in the 5% DMRT test.

Seeds with low moisture content are able to produce good germination, such as shallot TSS seeds and coated cucumber seeds which are able to provide an average germination value of 92.5% and 98.25%. Meanwhile, red chili seeds that have a higher water content only produce a lower average germination value of 84.25%. The use of Carboxylmethyl cellulase (CMC) 1.5% can increase seed viability because Carboxylmethyl cellulase (CMC) is a carbohydrate that can be used as a good carrier with a concentration of 1–1.5% to form a stable and homogeneous viscosity, so as to coat the seeds compactly and affect viability [12]. In line with Ani's statement (2018) which states that Carboxylmethyl cellulase (CMC) has good hydrophilic properties so that germination areas that provide a lot of water are absorbed by seeds and form more normal sprouts with a higher vigor index.

3.3 Vigor Index (%)

The results of the analysis of variance showed that the seed coating treatment had a significant effect on the vigor index of rice seeds, shallot TSS seeds, red chili seeds, and cucumber seeds. Sprout vigor index test is conducted to determine the ability of seeds to grow normally well, strong and have a normal sprout structure. The results of the seed coating material treatment showed that there were normal, abnormal, and dead seeds. The vigor index of rice seeds from seed coating with CMC 1.5% + liquid smoke 0.5% + $CaCO_3$ 8 g + gypsum 32 g is the highest vigor index. The high vigor index value of the seed coating indicates that the seeds have a higher potential to grow in the field compared to seeds without seed coating. The vigor index can monitor the actual condition of the membrane, low germination indicates membrane damage to the seed. Seeds with high vigor are seeds that grow quickly and synchronously (Table 3).

The results of coating on all seed commodities were able to produce an average value of vigor index above the standard except for the seed coating treatment on red chili seeds which inhibited seed vigor with a value of 14.75%. Based on these results, the rice seeds, shallot TSS seeds, and cucumber seeds from the coating have strong vigor. According to [13] indications of high vigor are indicated by the ability to grow above 60%.

Table 3. Average Vigor Index of Rice Seeds, Red Onion TSS Seeds, Red Chili Seeds, and Coating Cucumber Seeds.

Seed Coating Materials	IV (%)
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Gypsum 32 g	72,50a
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Dolomite 32 g	65,75a
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Lime Tohor 32 g	64,25a
Red Onion TSS Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	78,00a
Red Chili Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	14,75b

Notes: Numbers accompanied by the same letter in the same column show no significant difference in the 5% DMRT test.

Table 4. Average Growth Speed of Rice Seeds, Red Onion TSS Seeds, Chili Seeds Red, and Coated Cucumber Seeds.

Seed Coating Materials	(KcT) (%/etmal)
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Gypsum 32 g	24,87b
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Dolomite 32 g	24,81b
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Lime Tohor 32 g	64,25b
Red Onion TSS Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	23,84b
Red Chili Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	9,46b

Notes: Numbers accompanied by the same letter in the same column show no significant difference in the 5% DMRT test.

3.4 Growth Rate (KcT) (%/etmal)

The results of the analysis of variance showed that the seed coating treatment significantly affected the growing speed of rice seeds, TSS shallot seeds, red chili seeds, and cucumber seeds. Rice seeds from seed coating CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Lime Tohor 32 g produce seeds with the highest average growth speed, which is 37.50%/ethmal. The results of coating on all seed commodities provide an average value of growing speed above the standard, except for the seed coating treatment on red chili seeds which inhibits the speed of seed growth with a value of 9.46%. Based on these results, the rice seeds, shallot TSS seeds, and cucumber seeds from the coating have strong vigor. According to [13], a good growth speed ranges from 20–30% (Table 4).

CMC composition of 1.5% accelerates the growth of seed sprouts because Carboxylmethyl cellulase (CMC) has hydrophilic properties so that the germination area provides a lot of water absorbed by seeds and forms more normal sprouts with a higher vigor index [4] This is supported by the statement of [8] that Carboxylmethyl cellulase (CMC) also functions as an imbibition regulator. The properties that must be possessed by the

Table 5. Average Sprouting Fertility of Rice Seeds, TSS Red Onion Seeds, Chili Seeds Red, and Coated Cucumber Seeds.

Seed Coating Materials	(KcT) (%/etmal)
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Gypsum 32 g	24,87b
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Dolomite 32 g	24,81b
Rice Seed + CMC 1.5% + Liquid Smoke 0.5% + $CaCO_3$ 8 g + Lime Tohor 32 g	64,25b
Red Onion TSS Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	23,84b
Red Chili Seed + CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g	9,46b

Notes: Numbers accompanied by the same letter in the same column show no significant difference in the 5% DMRT test.

coating material are easy to break and dissolve when exposed to water, especially if the concentration is appropriate, so as not to inhibit the speed of seeds in germination.

3.5 Uniformity of Growth (KsT) (%)

The results of the analysis of variance showed that the seed coating treatment had a significant effect on the uniformity of growth of rice seeds, shallot TSS seeds, red chili seeds, and cucumber seeds. The results of coating on all seed commodities obtained an average value of growth uniformity above the standard. Seed coating material CMC 1.5% + liquid smoke 0.5% + $CaCO_3$ 8 g + gypsum 32 g produces seeds with the highest average growth uniformity, which is 100% [14] stated that the uniformity of good seed growth ranges from 40%–70%. The high value of growth speed and uniformity of seed growth is also supported by seed aging during storage. Seeds that have not experienced aging will have enough food reserves. The lowest average value of uniformity of growth was obtained in red chili seeds at 56.25%/ethmal (Table 5).

Simultaneous growth has a value directly proportional to the speed of growth. According to [15], the vigor index value is a value that can represent the speed of seed germination, which indicates that the seed is vigorous. The speed of growth indicates the vigor of growth power, while the uniformity of growth indicates the vigor of storage power. Seeds that have a high rate of growth are more capable of growing with good uniformity [16] argues that the use of 1.5% Carboxylmethyl cellulase (CMC) provides an increase in weight of only 9%, thus improving seedling performance.

4 Conclusion

Seed coating treatment positively affected the moisture content, viability, and vigor of rice seeds, shallot TSS seeds, and cucumber seeds, but negatively affected the moisture content, viability, and vigor of red chili seeds. The composition of the coating material CMC 1.5% + liquid smoke 0.5% + $CaCO_3$ 8 g + gypsum 32 g produced the highest quality of rice seeds, while the coating material CMC 1.5% + Humic Acid 0.6% + Gypsum 20 g could improve the quality of shallot TSS and cucumber seeds. The composition of the seed coating material can react well compared to other materials, so it does not inhibit the germination of rice seeds.

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