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Original Paper

Effect of Gibberellic Acid (GA_3) Concentration and Seedling Media Composition on the Germination and Growth of Shallots (*Allium ascalonicum* L.) from True Shallot Seed

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Abstract*—Shallots (*Allium ascalonicum* L.) is a vegetable commodity that contributes greatly to horticultural production and inflantion levels. The use of superior seeds is expected to produce maximum shallot production. The majority of Indonesian farmers use 30% of the harvested tubers as planting material, with production costs being quite expensive. Many shallot farmers also experience several problems with tuber seeds that are hollow and damaged. True Shallot Seeds can be an efficient and profitable alternative planting material. Implementing TSS shallot cultivation is considered difficult and requires longer time for sowing. Soaking seeds using Gibberelin can have a physiological effect on the germination process. Seedling media factor with a certain composition are needed to produce maximum seeds. The experiment was carried out in factorial manner using Completely Randomized Design with three replications. The GA_3 concentration factor has four treatment levels: G_0 = 0 ppm/control, G_1 = 2 ppm, G_2 = 4 ppm, and G_3 = 6 ppm. The seedling media composition factors has four treatment levels: M_0 = soil + compost/control (1:1), M_1 = cocopeat + compost (1:1), M_2 = husk charcoal + compost (1:1), and M_3 = sand + compost (1:1). The data analysis used was Analysis of Variance, if there were significant differences between the treatments, a further test was carried out using Duncan's Multiple Range Test at the 5% level. The result showed that the interaction between GA_3 concentration treatment and seedling media composition and the single factor GA_3 concentration had no significant effect on all observed variables. The composition of the seedling media has a significant effect on the speed of seed growth, seed height, root length, and seed wet weight with optimum results for germination and vegetative growth of TSS seeds, namely the composition of soil+compost/control (M_0) seedling media on the variables of seed growth speed (%/etmal), seed height (cm), and seed wet weight (gram).

Keywords*—True Shallot Seed, GA_3 Concentration, Seedling Media

I. INTRODUCTION

Shallots (*Allium ascalonicum* L.) are one of the leading horticultural commodities which contribute greatly to horticultural production and inflation levels in Indonesia [1]. Providing superior seeds as planting material really supports shallot production, where shallots can be cultivated from seeds originating from bulbs and seeds originating from True Shallot Seed (TSS) [2], [3]. The majority of farmers in Indonesia generally still use around 30% of the harvested tubers as a source of planting material [4]. The cost of farming from tuber seeds is relatively expensive, reaching 60% of the total production costs and other problems such as the large number of empty tubers during seed distribution also hamper the provision of planting material in the field [5].

True Shallot Seeds which are sown as seedlings can be an alternative for providing planting material that is more efficient and profitable [6]. However, currently using TSS seeds is still considered more difficult and takes longer than cultivating using tuber seeds with a seeding time of 42 days after sowing [7]. Seeds that are susceptible to deterioration during the storage period also affect the low percentage of growth in the field which results in decreased viability [8].

The length of seed germination will limit the fulfillment of planting material. Because seeds have a highly hard skin structure, they require particular treatment before being planted in order to be used for plant growth [9]. *Gibberellic Acid (GA3)* as a growth regulator which plays a role in stimulating the seed germination process can be given as a seed treatment before the seeds are sown [10]. Gibberellin exerts a physiological effect on germination by encouraging the activity of hydrolysis enzymes in seeds and mobilizing food reserves needed for the embryo to grow. Providing GA_3 at the right concentration is expected to produce faster growth than without GA_3 treatment. The main requirement for sowing TSS seeds with optimum seeding media

conditions will also support the growth of seeds that have a low growth percentage and germinate for a long time [11]. The combination of seed soaking treatment and seeding media composition aims to determine the response to germination and vegetative growth of TSS seedlings during sowing.

II. METHODOLOGY

A. Time and Place of Study

The research was carried out in May – July 2023 and was carried out in a greenhouse located in Bangsri, Kertosono, Nganjuk.

B. Research Procedure

The materials and tools used in the research include red onion seeds from the Sanren F1 variety, distilled water, soil, cocopeat, sand, compost, husk charcoal, Growth Regulator *Gibberellic Acid* (GA_3) GibGro 20 TB, *Fly insect trap*, fungicide Besromil, 3 thinwall cup 450 ml, plastic wrap, lable, *polybag* with size of 25 cm x 25 cm, tweezers, injection tool, shovel, 20 liter bucket, measuring cup, hand sprayer, ruler, digital scale, camera, calculator and stationery.

The research procedure included diluting GA_3 using distilled water according to the specified concentration and then soaking the seeds in thinwall for 48 hours. Next, prepare the seedling media with each composition into polybags weighing 650 grams. The seeds that have been soaked are then planted with 10 seeds in a polybag. Seedling care includes watering 3 times a day, fertilizing 50 ml/polybag at the age of 21 and 28 days after sowing, and controlling pests and plant diseases. Harvesting of seeds is carried out at the age of 42 days after sowing.

C. Experimental Design

The experiment was carried out factorially using the basic pattern of a Completely Randomized Design (CRD) with 3 replications. The first factor is soaking the seeds with a concentration of GA_3 which consists of 4 treatment levels, namely, G_0 = 0 ppm/without GA_3 (control), G_1 = 2 ppm, G_2 = 4 ppm, and G_3 = 6 ppm. The second factor is the composition of the seedling media which consists of 4 treatment levels, namely, M_0 = soil + compost (1:1) (control), M_1 = cocopeat + compost (1:1), M_2 = husk charcoal + compost (1:1), and M_3 = sand + compost (1:1). Observation variables included germination capacity, seed growth speed, seed height, number of leaves, root length, and seed wet weight. Observation data were analyzed using Analysis of Variance, if there were significant differences between treatments then further tests were carried out using Duncan's Multiple Range Test at the 5% level.

III. RESULTS AND DISCUSSION

Analysis of the influence of GA_3 concentration and seedling media composition on all observation variables is presented in Table 1.

TABLE 1. SUMMARY OF VARIETY ANALYSIS RESULTS (F-COUNT) ON ALL OBSERVATIONAL VARIABLES

No.	Observation Variables	F-Count		
		Concentration of GA_3 (G)	*Seed Media Composition (M)*	*Interaction (GxM)*
1	Germination Power	1,085 ns	2,061 ns	0,550 ns
2	Seed growth rate	1,289 ns	3,325 *	1,601 ns
3	Seedling height	2,099 ns	31,738 **	1,692 ns
4	Number of leaves	0,100 ns	2,767 ns	1,522 ns
5	Root length	1,845 ns	11,194 **	1,484 ns
6	Seedling wet weight	0,765 ns	4,910 **	1,195 ns

Note: ns = not significantly different, * = significantly different, ** very significantly different

A. Interaction Effect of Gibberelic Acid (GA_3) Concentration on Seed Soaking and Seedling Media Composition on Germination and Vegetative Growth of Shallots (*Allium ascalonicum* L.) from True Shallot Seed

The interaction results were not significantly different from the combination of seed soaking treatment with GA_3 and seedling media composition because success in vegetative growth was more influenced by seed quality and environmental factors. The TSS seed quality factor used is thought to have entered a phase of seed deterioration (deterioration) due to its long shelf life so that the GA_3 concentration which is considered low is also unable to overhaul the activity of hydrolysis enzymes and mobilize food reserves during the germination process. Environmental factors that support vegetative growth include seedling media, humidity, light and water. According to [12], The results of research using the interaction of PGR treatment (IAA and BAP) and planting media on violces leaf cuttings gave results that had no significant effect on all observed variables. This is influenced by larger genetic and environmental factors.

B. Main Effect of Gibberelic Acid (GA_3) Concentration Factor in Soaking Seeds on Germination and Vegetative Growth of Shallots (*Allium ascalonicum* L.) from True Shallot Seed

The results were not significantly different from the gibberellin concentration treatment for all observation variables, which was influenced by the administration of low concentrations. It is thought that the relatively low concentration of gibberellin will not be able to activate hydrolysis enzymes (α-amylase) in changing macro molecules in the endosperm to stimulate embryo growth. Apart from that, soaking seeds in large quantities at each treatment level unit also reduces the effectiveness of gibberellin absorption into the seeds at a predetermined concentration. According to [13], gibberellin, which plays a role in the breakdown and mobilization of food reserves in seeds, also does not work optimally after the imbibition process if gibberellin is given at an inappropriate concentration.

The TSS seed soaking treatment with GA_3 only increased the average percentage of germination to 78.54% from the minimum germination percentage stated on the seed packaging,

namely 75%, meaning that the increase in germination power did not occur significantly. According to [14], the potential for seed growth will end at a survival level of 90 – 75%. Next, seed deterioration will occur very quickly until the survival level is 25 – 10%, then the deterioration slows down and the seeds will die.

C. *Main Influence of Seedling Media Composition Factors on the Germination and Vegetative Growth of Shallots (Allium ascalonicum* L.*) from True Shallot Seed*

Based on the results of the analysis of variance, it shows that the main effect of seedling media composition has a very significantly different effect on the variables of seed height, seed wet weight and primary root length and has a significantly different effect on the seed growth speed variable, but has an insignificant different effect on the germination variable and number of leaves. The following is a graph of the results of the Duncan 5% multiple distance test for each variable which shows very significantly different results and is presented in Fig 1.

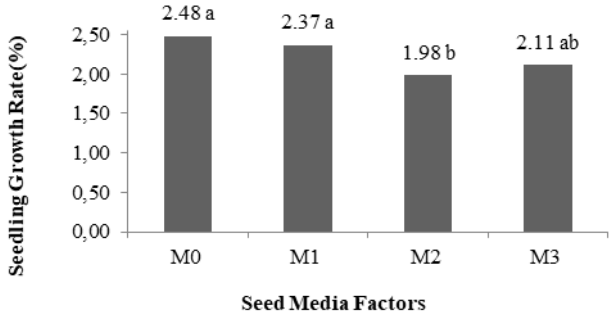

Fig 1. Influence of Seedling Media Composition Factors on Seed Growth Speed

The observation variable for seed growth speed with the best results was obtained from the soil + compost (M_0) seedling media composition treatment with a percentage of 2.48%/ethmal. The combination of soil and compost properties with loose consistency, fine dusty clay, light mass, good aeration and sufficient media fertility is considered effective for obtaining faster germination. The condition of the water content in the soil + compost seeding media that enters the seeds is quite optimal for the imbibition process, so that the initial germination process, which is marked by the emergence of the radicle, occurs more quickly compared to other seeding media. Crumb seedling media will make it easier for the cotyledons to be lifted so they appear on the surface of the media. According to [15], The combination of soil + compost planting media is able to meet the needs of the germination phase such as balanced nutrients and seed water content for better seed growth speed (3.40%/etmal) compared to other planting media for laban (*Vitex pinnata*) germination.

The observation variable for seed height with the best results was obtained from the sand + compost (M_3) seedling media composition treatment with a height of 26.03 cm. Thus, the wet weight variable for the seeds with the highest yield was found in the sand + compost (M_3) seeding media treatment of 0.56 grams.

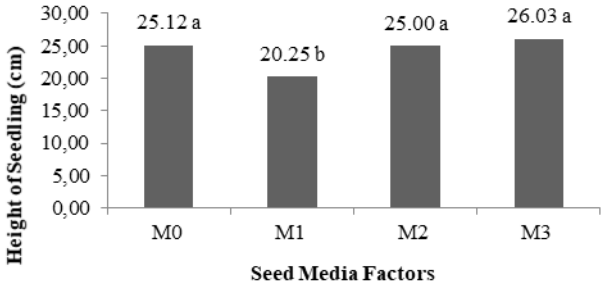

Fig 2. Influence of Seedling Media Composition Factors on Seedling Height

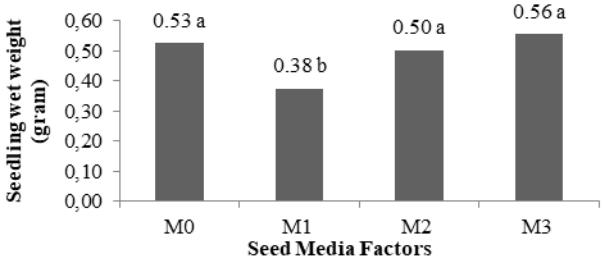

Fig 3. Influence of Seedling Media Composition Factors on Wet Weight of Seedlings

The highest seed wet weight results were correlated with the seed height parameter from the composition of the sand + compost seedling media. Sand seedling media has quite large pores (macro pores), where these pores will be filled with air and water, so when water and fertilizer are applied, the sand media will get wet quickly and water will be easily absorbed in it. The nature of the sand media mixed with compost keeps the media wet and does not dry out easily, so that water and nutrients can be retained. Increasing seed height is related to the elongation and enlargement of plant cells. According to [16], the higher the water content at a certain limit, the faster the growth.

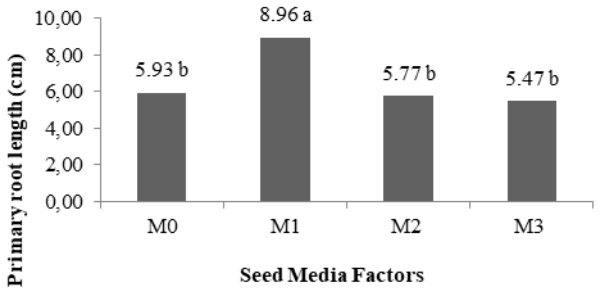

Fig 4. Effect of Seedling Media Composition Factors on Primary Root Length

The root length observation variable with the best results was obtained from the treatment with the composition of cocopeat + compost (M_1) seedling media with a length of 8.96 cm. Cocopeat seedling media has very light properties, making it easy for the roots to penetrate and spread deeper into the seedling media. Its water-absorbing properties are able to maintain the availability of water and nutrients for longer than other seedling media, however, cocopeat seedling media is considered less suitable for growing TSS shallot seedlings. The

role of the seedling media focuses more on root growth but does not support growth in the parameters of seed height, number of leaves and wet weight of seedlings. Cocopeat seedling media causes conditions in the media to become saturated with water and reduces air exchange in the media, thereby inhibiting plant growth [17].

The different results were not significantly different for this germination variable because the TSS seeds of the Sanren variety used had entered the seed deterioration phase with the average germination percentage in this study being 78.54%. This result did not increase significantly with the minimum germination percentage on the seed packaging, namely 75%. The potential viability of seeds will decrease along with the length of the storage period which affects the low physiological quality of the seeds during the initial germination process. Seeds that experience deterioration cause reduced germination, where the ability to grow in suboptimum conditions also decreases [13]. Meanwhile, the results were not significantly different in the number of leaves variable, thought to be due to environmental influences in the form of lighting intensity that did not meet the full light standard of up to 70% [18]. Unpredictable weather conditions which often occur overcast in the morning and the design of the greenhouse building which is not in accordance with the requirements for growing shallot seeds from seeds at the research location have hampered the photosynthesis process for optimal leaf formation.

IV. CONCLUSION AND SUGGESTION

A. Conclusion

The interaction between Gibberellic Acid (GA_3) concentration and seedling media composition had no significant effect on all observed variables. Gibberellic Acid (GA_3) concentration had no significant effect on all observed variables. The composition of the seedling media has a significant effect on the variables of seed growth speed, seed height, root length and seed wet weight. The seeding media composition treatment that provides optimum results for germination and vegetative growth of TSS seeds is the composition of soil + compost/control (M_0) seedling media on the variables of seed growth speed (%/etmal), seed height (cm), and seed wet weight (grams).

B. Suggestion

Researchers suggest the need for intensive control and attention to environmental factors for sowing TSS seeds in accordance with growth requirements to achieve maximum seed products. The use of seedling media can be considered because it has the potential to carry soil-borne pathogens, which is done because TSS seeds are very susceptible to Phythium pathogens (seeding damping off) during the vegetative phase.

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