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# Response of growth and tuber seed production of $G_0$ potato (*Solanum tuberosum* L.) cv Medians in medium lands of Jatinangor to biochar composition and retardant type

**Abstract** Potatoes are the third most consumed food in Indonesia. The availability of high-quality potato tuber seeds is still low which affects potato production. Potato planting in the highlands is limited, so it needs to be expanded into medium lands. The modification that can increase the production of G0 potato tuber seeds on medium lands is the use of biochar and retardant. The purpose of this research was to determine the composition of biochar and the type of retardant to increase the G0 tuber seed yield of potato cv Medians in the medium lands of Jatinangor. The research was conducted from August 2022 to February 2023 at the Station Ciparanje, Jatinangor, Faculty of Agriculture, Universitas Padjadjaran. The experiment used Factorial Randomized Block Design (RBD). The first factor was the biochar compositions: b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar), and b4 (80% compost + 10% biochar husk rice + 10% coconut shell biochar). The second factor was the retardant type: r1 (without retardant), r2 (100 ppm paclobutrazol), and r3 (100 ppm prohexadione-Ca). The experimental results showed that there was no interaction effect of biochar compositions and retardant type on the growth and yield of G0 potato tuber seeds. Treatment of 80% compost + 20% coconut shell biochar suppressed plant height but increased the number of tubers. Treatment of 100 ppm paclobutrazol resulted in lower plant height but total chlorophyll content, percentage of stolon forming tubers, the number of tubers, and tuber weight per plant were higher compared to treatments without retardant and with 100 ppm prohexadione-Ca.

**Keywords:** Biochar · Medium lands · Potato · Retardant · Seed

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## Introduction

The potato (*Solanum tuberosum* L.) is one of the horticultural commodities with a high source of carbohydrate content, so it has the potential to be used in food diversification programs. Apart from being a source of carbohydrates, potatoes are rich in nutritional value, including minerals and vitamins, so they are included in the types of vegetables with high economic value, both as fresh and processed ingredients. This is due to potatoes being the third most widely consumed food in Indonesia, following rice and wheat (Statistics Indonesia, 2022b).

Statistics Indonesia (2022) states that potato production in Indonesia in 2021 has increased by 6.1% from 2020. However, potato production achieved in Indonesia in 2021 is still low because it can only meet Indonesia's potato consumption needs of 49.8%. The low production of potatoes in Indonesia is due to the low availability of good quality and quantity potato seeds (Hamdani et al., 2020). An essential factor for increasing potato production is the availability of high-quality seeds in sufficient quantities. Mulyono et al. (2017) stated that potato plants derived from G0 seeds had the highest increase in production.

Data from Statistics Indonesia (2022) shows that the harvested area of potato plants in Indonesia in 2021 decreased by 8% from 2020. One of the efforts to overcome this problem is the expansion of potato cultivation in medium lands, which is widely available in Indonesia. Differences in growing environmental conditions between the highlands and the medium lands are related to differences in temperature. According to Basu & Minhas (1991) in Prabaningrum et al. (2014), plants can experience high-temperature stress, which can increase gibberellin synthesis resulting in decreased photosynthate translocation to potatoes and increased translocation to leaves and stems.

In general, the soil in the medium lands is mostly Inceptisols. Inceptisols generally have less fertile soil properties, including slightly acidic soil pH, moderate C-organic levels, and low NPK nutrients (Yuniarti et al., 2020). However, it can still be improved with proper handling and technology. One way that can be done to increase the number and size of potato tuber seeds in the medium lands is by adding organic matter and biochar such as compost, rice husk charcoal, and coconut shell charcoal. In line with the results of Hamdani et al. (2017), the application of ameliorants consisting of compost, coconut shell biochar, and dolomite can increase the number of tubers, and tuber weight per plant. According to the research results of Hamdani et al. (2019), the composition of the soil media, compost, rice husk charcoal, and cocopeat (1: 1: 1: 1) produced the highest values for the number of tubers and the weight of tubers per plant. However, the composition of the media is more expensive because there is more organic matter than the soil media. Thus, finding a cheaper media composition with a higher proportion of soil for G1 seed production in the medium lands is necessary.

Apart from planting media, another way that can be done is by applying growth regulatory substances, which can regulate the balance of plant growth. At the medium lands, elevated temperatures can lead to the accelerated synthesis of gibberellin at the tips of stems, young leaves, and roots, which function in the elongation and expansion of organs through cell growth which causes plants to become taller, slender, and chlorotic so that it has an impact on the potatoes formed few and small (Sumadi et al., 2015). Growth regulators that act as growth inhibitors include paclobutrazol and prohexadion-Ca (Hernawati et al., 2022).

From the problems in the medium lands, the composition of biochar and the correct type of retardant for planting potatoes in the medium lands has yet to be discovered. Therefore, this study aims to examine the effect of biochar composition and types of retardants on the growth and yield of potato cultivar medians in medium lands.

## Materials and Methods

The experiment was carried out from August 2022 to February 2023 at the Ciparanje Experimental Field, Faculty of Agriculture, Universitas Padjadjaran, with an altitude of ± 752 m above sea level.

The materials used in this experiment were potato seed G0 of the Medians cultivar, the soil of the order Inceptisol originating from the Ciparanje experimental field, compost, rice husk biochar, coconut shell biochar, Goldstar 250 SC (active ingredient Paclobutrazol 250 g/L), Prodex (active ingredient Prohexadione-Ca 15%), poly bag size 30 x 30 cm, plastic shade,

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acetone 80%, label, urea fertilizer (46% N), SP-36 fertilizer (36% P2O5), fertilizer KCl (48% K2O), basamid 98 GR (98% Dazomet), insecticide Curracron 500 EC (500 g/L Profenofos), bactericidal Plantomycin (6.87% Streptomycin sulfate), fungicide Curzate 8/64 WP (64% Mankozeb ) and the nematicide Furadan 3G (3% Carbofuran). The tools used in this experiment were hoes, weeding hoe, watering can, stake, measuring cup, hand sprayer, thermohygrometer, leaf porometer, spectrophotometer, test tubes, digital scales, oven, brown envelopes, and documentation equipment.

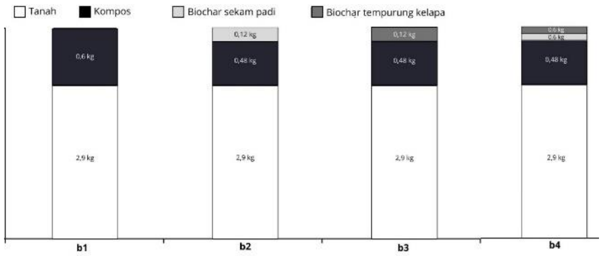


**Figure 1. Four different biochar composition treatments**

The experimental design used was a factorial randomized block design (RBD) consisting of two factors and three replications. The first factor is Biochar Composition (B), which consists of four levels, namely, b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar) and b4 (80% compost + 10% rice husk biochar + 10% coconut shell biochar). The second factor is Retardant Type (R), which consists of three levels, namely, r1 (Without Retardant), r2 (100 ppm paclobutrazol), and r3 (100 ppm prohexadion-Ca). Each experimental unit consisted of 5 plants, so there were 180 experimental plants placed according to the layout of the experiment.

Soil sterilized with basamid is given compost, rice husk biochar, and coconut shell on inceptisol soil following the proportions in Figure 1. The compost and biochar are weighed first with the dose used, which is 20 tonnes/ha (Rahayu, 2019). Then, the soil media was mixed according to the composition of the biochar treatment and put into polybags with the final weight of each treatment weighing 3.5 kg/polybag (polybag size 30 x 30 cm).

The application of paclobutrazol and prohexadion-Ca according to the treatment with a concentration of 100 ppm was applied twice to the plants at 30 and 40 DAP. The volume of paclobutrazol and prohexadion-Ca used was based on the results of the previous calibration. The application of paclobutrazol and prohexadion-Ca is by spraying all the plant leaves using a sprayer.

Observations consisted of analysis of physical properties and pH of the planting media, plant height, total chlorophyll content, leaf carotenoid content, stomatal conductance, relative growth rate, tuber growth rate, plant dry weight, number of tuber and tuber weight per plant, and percentage of tuber seed class S, M and L. Experimental data on the effect of treatment were processed statistically using the F test at 5% significance level, while the difference in mean values between treatments using Duncan's Multiple Range Test analysis method at 5% significance level using SPSS data processing software version 23.0.

## Results and Discussion

**Analysis of the physical properties and pH of the planting media:** The results of the analysis of the physical properties and pH of the planting media in the experiment can be seen in Table 1. The 100% compost (b1) treatment had a higher density of 0.82 kg/L. The high density of the planting media indicates the denser the planting media, which means it is difficult to transmit water. These conditions can reduce porosity, causing a reduction in air space and water holding capacity of the planting media, which can inhibit root growth in controlling its capacity to absorb water and nutrients (Yulina & Ambarsari, 2021).

The mixture of planting media with a higher percentage of porosity and percentage of water holding capacity is 80% compost + 20% coconut shell biochar due to the addition of coconut shell biochar which has a larger surface area, the larger the pores of the biochar. This affects the ample space for air and water, which can increase the surface area of the pores of the planting media. The greater the space for air and water in the pores of the planting media, the planting media can absorb water to maintain its water content (Agviolita et al., 2021).

A mixture of 80% compost + 10% rice husk biochar + 10% coconut shell biochar has a higher percentage of air space, namely 12.40%. The greater the percentage of air space in the planting media, the more oxygen is stored so that the respiration process of plant roots goes well.

The initial soil pH in the experiment was classified as neutral, namely 6.77, which was not under the pH needed by potato plants. The results of the laboratory analysis in Table 1 show that the pH of the treated biochar composition ranged from 5.87 to 6.48. The biochar composition is suitable for potato plants because the pH needed by potato plants is 5.0 – 6.5 (Diwa et al., 2015). The addition of compost and biochar in this experiment can lower the soil pH, making it suitable for the growth of potato plants.

**Plant Height, Leaf Area Index, Plant Dry Weight, and Root-Shoot Ratio.** The analysis results showed no interaction effect between the composition of biochar and the type of retardant on plant height, leaf area index, plant dry weight, and root-shoot ratio. However, independently the treatment of the biochar composition had a significant effect on plant height, while the retardant type had a significant effect on plant height, plant dry weight, and root-shoot ratio (Table 2).

Table 2 shows that a mixture of 80% compost + 10% rice husk biochar + 10% coconut shell biochar produced higher plant height than the other treatments but was not significantly different from the mixture of 80% compost + 20% rice husk biochar. The addition of rice husk biochar and coconut shell biochar to the planting media mixture increases soil porosity, water holding capacity, and air space so that it can improve the physical properties of the planting media and increase the availability of water and nutrients, which will make it easier for roots to absorb nutrients which will be transported to the vegetative parts of the plant so that vegetative growth such as plant height can be more optimal (Hamdani et al., 2020).

Treatment of 100 ppm paclobutrazol effectively suppressed plant height growth, plant dry weight, and root-shoot ratio. The application of paclobutrazol can inhibit the activity of gibberellin GA3 synthesis. GA inhibition causes plant cells to continue dividing, but new cells do not elongate, so branches with shorter book lengths are formed, resulting in shorter plant heights.

**Table 1. The results of the analysis of the physical properties and pH of the growing media**

| Treatment | Density (kg/L) | Porocity (%) | Airspace (%) | Water Holding Capacity (%) | pH Media |
|---|---|---|---|---|---|
| b1 | 0.84 | 44.25 | 9.50 | 33.85 | 5.99 |
| b2 | 0.72 | 48.00 | 10.40 | 38.50 | 5.87 |
| b3 | 0.82 | 53.00 | 11.35 | 41.65 | 6.48 |
| b4 | 0.75 | 49.00 | 12.40 | 36.60 | 5.97 |

Description: b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar) and b4 (80% compost + 10% rice husk biochar + 10% coconut shell biochar).

**Table 2. Effect of biochar composition and type of retardant on plant height, leaf area index, plant dry weight, and root-shoot ratio**

| Treatment | Plant Height 60 DAP (cm) | Leaf Area Index | Plant Dry Weight (g) | Root-Shoot Ratio |
|---|---|---|---|---|
| **Biochar Composition (B)** | | | | |
| b1 | 30.12 a | 4.38 | 10.09 | 7.57 |
| b2 | 35.37 b | 4.58 | 9.71 | 8.54 |
| b3 | 28.59 a | 4.27 | 9.75 | 7.90 |
| b4 | 37.84 b | 4.72 | 9.15 | 8.02 |
| **Retardant Type (R)** | | | | |
| r1 | 37.08 b | 4.78 | 12.06 b | 9.76 b |
| r2 | 27.08 a | 3.98 | 7.34 a | 6.72 a |
| r3 | 34.78 b | 4.71 | 9.62 ab | 7.54 ab |

Description: DAP is days after planting. b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar), b4 (80% compost + 10% rice husk biochar + 10% coconut shell biochar), r1 (Without Retardant), r2 (100 ppm paclobutrazol), and r3 (100 ppm prohexadion-Ca). Numbers marked with different letters represent significantly different according to Duncan's Multiple Range Test at the 5% level.

**Table 3. Effect of biochar composition and type of retardant on total chlorophyll content, leaf carotenoid content, and stomatal conductance**

| Treatment | Total Chlorophyll Content (mg/l) | Leaf Carotenoid Content (µmol/g) | Stomatal Conductance (mmol H2O m-2 s-1) |
|---|---|---|---|
| **Biochar Composition (B)** | | | |
| b1 | 31.36 | 1391.57 | 184.84 |
| b2 | 29.28 | 1336.90 | 178.39 |
| b3 | 31.46 | 1295.45 | 201.33 |
| b4 | 30.39 | 1441.04 | 199.35 |
| **Retardant Type (R)** | | | |
| r1 | 28.61 a | 1093.35 a | 155.94 a |
| r2 | 33.23 b | 1484.45 b | 206.85 b |
| r3 | 30.03 a | 1520.92 b | 210.15 b |

Description: DAP is days after planting. b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar), b4 (80% compost + 10% rice husk biochar + 10% coconut shell biochar), r1 (Without Retardant), r2 (100 ppm paclobutrazol), and r3 (100 ppm prohexadion-Ca). Numbers marked with different letters represent significantly different according to Duncan's Multiple Range Test at the 5% level.

When observing the dry weight of plants and the ratio of root-shoots, the plants entered the age of 60 DAP, so the potato plants had entered a phase in the formation of potatoes towards the old phase. In this phase, more photosynthate in the leaves is translocated to fill the potato. This is supported by Hamdani et al. (2018), that the application of paclobutrazol at 45 DAP enters the end of the plant growth phase, so the photosynthate results in the leaves are distributed for filling potatoes.

**Total Chlorophyll Content, Leaf Carotenoid Content, and Stomatal Conductance.** The analysis results showed no interaction effect between biochar composition and retardant type on total chlorophyll content, leaf carotenoid content, and stomatal conductance. However, the treatment of biochar composition had no significant effect on total chlorophyll content, leaf carotenoid content, and stomatal conductance, while the type of retardant had a significant effect on total chlorophyll content, leaf carotenoid content, and stomatal conductance (Table 3).

One of the factors that influence the formation of chlorophyll is water availability. The chlorophyll content, which was not significantly different, presumably indicated that all the treatments given were able to provide sufficient water for plants to carry out chlorophyll synthesis. The low availability of water can inhibit the absorption of nutrients because one of the functions of water is as a solvent for nutrients, especially nitrogen and magnesium, which play an essential role in the synthesis of chlorophyll. According to Zhao et al. (2015) in Yuniati (2020), increased stomatal conductance correlates with high water uptake by roots. The high stomatal conductance values show that plants are in good condition to carry out photosynthesis (Soleh et al., 2020).

Treatment of 100 ppm paclobutrazol resulted in the highest total chlorophyll content, carotenoid content, and stomatal conductance compared to the control treatment. Paclobutrazol can stimulate the synthesis of cytokinin hormones, which increases chloroplast differentiation and chlorophyll synthesis (Xia et al., 2018 in Yuniati, 2020) and encourages stomata opening (Pal et al., 2016 in Yuniati, 2020). Chlorophyll requires carotenoid accessory pigments, which can increase the binding of photons from sunlight in the light reaction of photosynthesis. Carotenoids can expand the range of light absorption by absorbing the spectrum of sunlight in the green-blue section, then passing it on to chlorophyll to help in photosynthesis (Hashimoto et al., 2016). Likewise, opening larger stomata and increasing stomatal density can increase CO2 concentration in chloroplasts which is a factor in increasing stomatal conductance (Xia et al., 2018 in Yuniati, 2020).

**Relative Growth Rate, Tuber Growth Rate, Number of Stolons, and percentage of stolons forming tubers**. The analysis results showed no interaction effect between the composition of biochar and the type of retardant on the relative growth rate, the tuber growth rate. the number of stolons, and the percentage of stolons forming tubers. However, independently the treatment of biochar composition had a significant effect on the growth rate of potatoes, while the retardant type had a significant effect on the growth rate of potatoes, the number of stolons, and the percentage of stolons forming tubers (Table 4).

Table 4 shows that a mixture of 80% compost + 20% rice husk biochar produced the highest tuber growth rate compared to the 100% compost treatment but was not significantly different from the mixture of 80% compost + 20% coconut shell biochar and 80% compost + 10% rice husk biochar + 10% coconut shell biochar. The addition of rice husk biochar and coconut shell biochar can create conditions for planting media with a reasonably fine structure, good drainage without a waterproof layer, and the availability of sufficient nutrients and water for optimal plant growth, especially in the process of photosynthesis so that the resulting photosynthate is channeled and stored as food reserves in potatoes.

Treatment of 100 ppm paclobutrazol produced the lower than number of stolons. However, the growth rate of potatoes and the percentage of stolons forming tubers were higher than the treatment without retardant but not significantly different from the 100 ppm prohexadion-Ca treatment. It is suspected that earlier retardant treatment applied two times (30 and 40 DAP) was able to increase the effectiveness and work of retardants in inhibiting gibberellin synthesis to inhibit stolon elongation. However, there was an increase in the percentage of stolons forming tubers.

**Table 4. Effect of biochar composition and type of retardant on relative growth rate, tuber growth rate, number of stolons and percentage of stolons forming tubers**

| Treatment | Relative Growth Rate | Tuber Growth Rate | Numbers of Stolon | Tuber Formed of Stolon (%) |
|---|---|---|---|---|
| **Biochar Composition (B)** | | | | |
| b1 | 0.021 | 0.46 a | 5.00 | 70.81 |
| b2 | 0.029 | 1.05 b | 5.88 | 55.59 |
| b3 | 0.031 | 0.55 ab | 4.44 | 47.96 |
| b4 | 0.053 | 0.63 ab | 5.22 | 49.88 |
| **Retardant Type (R)** | | | | |
| r1 | 0.020 | 0.22 a | 6.67 b | 38.37 a |
| r2 | 0.047 | 0.91 b | 4.00 a | 72.27 b |
| r3 | 0.034 | 0.89 b | 4.75 ab | 57.54 ab |

Description: DAP is days after planting. b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar), b4 (80% compost + 10% rice husk biochar + 10% coconut shell biochar), r1 (Without Retardant), r2 (100 ppm paclobutrazol), and r3 (100 ppm prohexadion-Ca). Numbers marked with different letters represent significantly different according to Duncan's Multiple Range Test at the 5% level.

**Table 5. Effect of biochar composition and type of retardant on the number of tubers, tuber weight and percentage of tuber seed quality class**

| Treatment | Number of Tubers (knol) | Tuber Weight (g per plant) | Percentage of Tuber Seed Quality Class | | |
|---|---|---|---|---|---|
| | | | S (%) | M (%) | L (%) |
| **Biochar Composition (B)** | | | | | |
| b1 | 5.18 a | 51.58 a | 95.00 | 5.00 | 0.00 |
| b2 | 6.18 b | 63.44 b | 94.05 | 5.95 | 0.00 |
| b3 | 6.29 b | 58.74 ab | 96.97 | 3.03 | 0.00 |
| b4 | 6.04 ab | 56.84 ab | 91.97 | 6.79 | 0.00 |
| **Retardant Type (R)** | | | | | |
| r1 | 5.22 a | 45.65 a | 98.33 | 1.67 | 0.00 |
| r2 | 6.38 b | 61.54 b | 91.79 | 8.20 | 0.00 |
| r3 | 6.17 b | 53.79 ab | 93.36 | 5.71 | 0.00 |

Description: DAP is days after planting. b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar), b4 (80% compost + 10% rice husk biochar + 10% coconut shell biochar), r1 (Without Retardant), r2 (100 ppm paclobutrazol), and r3 (100 ppm prohexadion-Ca). Numbers marked with different letters represent significantly different according to Duncan's Multiple Range Test at the 5% level.

**Table 6. Effect of biochar composition and type of retardant on shoot emergence time, seed germination percentage, and seeds weight loss**

| Treatment | Shoot Emergence Time (Day) | Seed Germination Percentage | Seeds Weight Loss (%) |
|---|---|---|---|
| **Biochar Composition (B)** | | | |
| b1 | 62.22 b | 44.44 | 2.95 |
| b2 | 38.88 a | 51.11 | 3.40 |
| b3 | 43.33 a | 31.11 | 4.81 |
| b4 | 45.55 a | 53.33 | 3.33 |
| **Retardant Type (R)** | | | |
| r1 | 40.00 | 33.33 | 4.16 |
| r2 | 45.83 | 53.33 | 3.62 |
| r3 | 50.83 | 48.33 | 3.09 |

Description: DAP is days after planting. b1 (100% compost), b2 (80% compost + 20% rice husk biochar), b3 (80% compost + 20% coconut shell biochar), b4 (80% compost + 10% rice husk biochar + 10% coconut shell biochar), r1 (Without Retardant), r2 (100 ppm paclobutrazol), and r3 (100 ppm prohexadion-Ca). Numbers marked with different letters represent significantly different according to Duncan's Multiple Range Test at the 5% level.

In line with the opinion of Hamdani et al. (2018) that the timing of paclobutrazol application is essential at the beginning of the tuber formation phase (30 DAP) because it can cause a decrease in shoot growth but can increase tuber formation due to increased assimilate which is diverted to the process of tuber formation. Observations made at 50 and 60 DAP entered the potato filling phase so that the growth rate would continue to increase.

**Number of Tubers, Tuber Weight, and Percentage of Tuber Seed Quality Class**. The analysis results showed no interaction effect between the biochar composition and the type of retardant on the number of tubers, tuber weight and percentage of tuber seed quality class. However, the treatment of the biochar composition had a significant effect on the number of tubers and the tuber weight, while the retardant type had a significant effect on the number of tubers and the tuber weight (Table 5).

A mixture of 80% compost + 20% coconut shell biochar produced numbers of tuber and tuber weight higher than the 100% compost treatment but was not significantly different from the other treatments. The high rate of tuber growth rate influences this because the addition of coconut shell biochar and rice husk biochar has a high percentage of porosity and water-holding capacity, so the water and air conditioning of the planting media is good for the growth and development of potatoes. In line with Rahayu's research (2019), the treatment of 80% compost + 20% coconut shell biochar produced the highest amount of tuber plant compared to the 100% compost treatment. Rafindo et al. (2022) stated that many pore spaces can increase the absorption of water and nutrients so that the photosynthetic capacity of plants increases. The photosynthetic capacity of plants is a factor in tuber formation.

The 100 ppm paclobutrazol treatment produced the highest number and weight of potatoes compared to the non-retardant treatment but was not significantly different from the 100 ppm prohexadion-Ca treatment. This is related to the concentration of the retardant given, which is 100 ppm, and the frequency of giving the retardant twice at 30 and 40 DAP. Based on the research results of Hamdani et al. (2018), the application of paclobutrazol at a concentration of 100 ppm can increase the weight of potatoes per plant compared to no application of paclobutrazol. Likewise, with the results of Aulia's research (2020), applying 100 ppm paclobutrazol and applying 100 ppm prohexadione-Ca at 40 DAP can increase the weight of potatoes. The retardant application time given at 30 and 40 DAP caused vegetative growth to be inhibited, and optimal assimilate transfer occurred to support the formation of potatoes because, at this age, the plant was entering the phase of potato formation.

The percentage value of class S G1 seed potatoes in the treatment of biochar composition and retardant types has a higher percentage than M and L classes. The high percentage of class S G1 seed potatoes in potato planting with the aim of seed production will follow market demand. In line with the results of research by Adiyoga et al. (2014) that respondent farmers prefer tubers measuring 30 - 40 g, which is included in class S G2 seed potatoes because it has a smaller weight and size, so it is easy to store and distribute.

**Time of Shoots Emergence, Percentage of Seeds Sprouting, and Weight Loss of Seeds.** The analysis results showed no interaction effect between the biochar composition and the type of retardant at the time of shoot emergence, the percentage of seeds sprouting, and the weight loss of seeds. However, independently the treatment of biochar composition had a significant effect on the time of emergence of shoots, while the retardant type had no significant effect on the time of emergence of shoots, percentage of seeds sprouting, and weight loss of seeds (Table 6).

The time the shoots appear is related to the breaking of the seed dormancy period, marked by the emergence of shoots. The potato dormancy period reaches three months to more than five months. Factors that affect the duration of dormancy include the place of planting during the growth period and the age of the potato in the field (Sahat et al., 1989 in Nuraini et al., 2016). The addition of biochar resulted in a faster shoot emergence than without the addition of biochar. This is related to the potato's higher weight value produced by adding biochar because there is a potential for food reserves contained in the potato, which is the result of photosynthesis, thereby accelerating the growth of new shoots. However, on observation 70 days after harvest, the percentage of germinated seeds was 31.1 –53.33%. This is presumably because, at that time, the potato was still dormant. At the time of observation, some of the tuber began to wrinkle on the skin of the tuber. This was influenced by the high weight loss of the tuber, which could result in changes in the physiological quality of the seeds. Wiersema (1989) in Purnomo et al. (2017) stated that water loss from potato tubers would be more significant if the potatoes had sprouted.

## Conclusion

From the experimental results and discussion, it can be concluded as follow.

1. There was no interaction between biochar composition and retardant type on the growth and yield of G0 potato seed cultivar Medians in the Jatinangor medium plains.
2. Providing 80% compost + 20% coconut shell biochar can reduce plant height and increase the number of tubers per plant.
3. Application of 100 ppm paclobutrazol resulted in lower plant height but produced the highest total chlorophyll content, number of tubers, and tuber weight per plant.

## References

Adiyoga, Suwandi W, Kartasih A. 2014. Farmers attitude towards attribute choices of potato seed and variety. J. Hort, 24(1): 76-84.

Agviolita P, Yushardi, Anggraeni FK. 2021. Effect of biochar variations on soil retention ability. Jurnal Fisika Unand, (10)2: 267-273.

Aulia MT. 2022. The effect of plant growth regulators on growth and yield of G0 potato cultivar medians seeds in medium altitude. Thesis. Faculty of Agriculture, Universitas Padjadjaran.

Diwa AT, Dianawati M, Sinaga A. 2015. Technical Instructions for Potato Cultivation. West Java Agricultural Technology Research Center. Agricultural Research and Development Agency. Ministry of Agriculture.

Hamdani JS, Nuraini A, Mubarok S. 2018. The use of Paclobutrazol and shading net on growth and yield of potato "medians" tuber of G2 in medium land of Indonesia. J. Agron., 17(1): 62 – 67.

Hamdani JS, Sumadi, Kusumiyati, Ruwaidah H. 2020. Effect of growing media compositions and watering interval to growth and yield of the G0 potato seed (*Solanum tuberosum* l.) cv medians in medium lands. Jurnal Kultivasi, 19(3): 1237–1246.

Hamdani JS, Dewi TP, Sutari W. 2019. Effect of growing media compositions and times of growth regulating substances application to growth and yield of the G2 potato seed (*Solanum tuberosum* L.) cv Medians in medium lands of Jatinangor. Jurnal Kultivasi, 18(2): 875–881.

Hashimoto H, Uragami C, Cogdell RJ. 2016. Carotenoids and Photosynthesis. Subcellular Biochemistry, 79: 111–139.

Hernawati D, Hamdani JS, Sumadi, Sumekar Y, Alfiya M. 2022. Physiological response, yield and quality of G0 potato (*Solanum tuberosum* L.) seed yield to various concentrations and time of application of prohexadione-ca bioregulator. Res.

Jurnal Kultivasi Vol. 23 (1) April 2024
ISSN: 1412-4718, eISSN: 2581-138x

Crop, 23: 640-648.

Mulyono D, Anwarudin MJ, Sayekti AL, Hilman Y. 2017. Seed class potatoes (*Solanum tuberosum* L.) based on growth, production and quality product. J. Hort, 29(2): 209 – 216.

Nuraini A, Sumadi, Pratama R. 2016. Application of cytokinin on dormancy breaking of potato seed G1 (*Solanum tuberosum* L.). Jurnal Kultivasi, 15(3): 202 - 207

Prabaningrum L, Moekasan T, Sulastrini. 2014. Potato Cultivation Technology in Medium Altitude Areas. Monografi No.34. ISBN : 978-979-8304-77-4.

Purnomo E, Suedy SW, Haryanti S. 2017. The methods and time storage effect on weight loss, glucose level, and carotenoid level of potato. Jurnal Anatomi dan Fisiologi, 2(2): 107 – 113.

Rafindo H, Dwipa I, Warnita. 2022. Modification of planting media and number of mini cuttings for increased growth and yield of G0 potato tubers. Jurnal Agrohita, 7(2): 373 – 379.

Rahayu RR. 2019. The effects of ameliorant composition and potassium fertilizer dosage on the growth and yield of G2 Median potato cultivar in medium altitude of Jatinangor. Thesis. Faculty of Agriculture, Universitas Padjadjaran.

Soleh MA, Anjarsari IRD, Rosniawaty S. 2020. Decreased value of stomatal conductance, light use efficiency, and growth components due to waterlogging in several genotypes of sugarcane. Kultivasi, 19(2): 1114-1118.

Statistics Indonesia. 2022. Potato Production in Indonesia. [Referred to 2022 Agustus 07] Available at http://www.bps.go.id/

Statistics Indonesia. 2022b. Executive Summary of Indonesian Population Expenditure and Consumption 2022. [Referred to 2023 Januari 25]. Available at http://www.bps.go.id/.

Sumadi, Suminar E, Murgayanti, Nuraini A. 2015**.** Effect of retardants substances on growth and seed tuber yield productivty of two potato cultivars (*Solanum tuberosum* L.) at medium land. Jurnal Kultivasi, 14(2): 49-54.

Yulina H, Ambarsari W. 2021. The relationship of water content and soil bulk weight to harvest weight of pakcoy plants in a combination of municipal waste compost and cow manure. Jurnal Agro Tatanen, 3(2).

Yuniarti A, Solihin E, Putri ATA. 2020. Application of organic and N, P, K fertilizer to pH, P-available, P-absorption, and black rice yield (*Oryza sativa* L.) in Inceptisol. J. Kultivasi, 19(1): 1040 - 1046.

Yuniati N, Hamdani JS, Soleh MA. 2020. Physiological responses of potato plant to the types of plant growth regulator under various drought stress condition in medium altitude. Jurnal Kultivasi, 19(1): 1053–1060.