

THE EFFECT OF PGR RED ONION EXTRACT ON THE GROWTH AND YIELD OF GREEN MUSTARD PLANTS (*Brassica juncea* L.)

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Abstract: Mustard plants are green plants that can be cultivated easily in various climatic conditions and can be consumed as a companion to cooking. In addition, mustard plants have enough content to meet the human body's needs. Giving a combination of PGR concentration of red onion extract and the right combination of media composition can affect mustard plants' growth and propagation system. This study aims to determine the effect of PGR red onion extract and the best composition of planting media, as well as to know whether there is an interaction between PGR and the composition of planting media regarding the growth and production of mustard plants. Sample selection is carried out using random sampling techniques in each population. The study was conducted in July-August 2023 in the Pasuruan City area using the 2-factor RAK (Group Random Design) research method. The first factor is the concentration of PGR, which consists of control (T0), concentration of 10% (T1), concentration of 20% (T2), and concentration of 30% (T3). The second factor is the composition of the planting medium with a ratio of soil, husk charcoal, and manure, namely (1: 2: 1) and (1: 1: 2). The results showed that the PGR factor of red onion extract with a concentration of 30% had a very real influence and gave the best results on the parameters of plant height, leaf width, and wet biomass of mustard plants. Planting media factors significantly affect and provide the best results in 1: 1: 2 treatment regarding plant height parameters at age 35-42 HST and wet biomass of mustard plants. The interaction between PGR and planting media has a real effect on the wet biomass of plants but does not have a real effect on plant height and leaf width of mustard plants.

Keywords: PGR, *Growing Media*, *Growth*, *Production*, *Mustard Plant*

INTRODUCTION

Mustard plants are green vegetables in great demand and preferred by consumers, not only as the main ingredient but also as a companion in cooking. Mustard greens have nutritional content such as fat, carbohydrates, protein, and several vitamins such as vitamin B and vitamin C. Mustard greens also contain β -carotene, which is vitamin A. Provitamin A in the body will turn into vitamin A. The content of β -carotene in mustard greens is quite high, around 99.23 mg / 100g. β -carotene is useful for preventing nearsightedness in chickens (*xerophthalmia*) [1,2].

Mustard plants include green vegetables that can grow in tropical or sub-tropical climatic conditions [3]. Mustard plants can easily be cultivated using various techniques. Planting media plays an important role in supporting the growth process in plants. One is to provide and meet the needs of nutrients and water absorbed by plant roots. Various types and compositions of planting media can be used for the cultivation process of mustard plants, including a mixture of soil, husk charcoal, and manure. The number of types of planting media can be compared to finding the appropriate composition to produce the best harvest [4,5].

The high public demand for quality vegetables (including mustard) demands innovation in cultivating mustard plants. Improving the quality and quantity of mustard plants is done by adding plant growth regulators (PGR). In the process of meeting consumer needs, both in terms of quality and quantity, many

efforts to accelerate growth are carried out, one of which is the addition of plant growth regulators (PGR). PGR is an additional supplement intended for plants to increase the course of cell division to become more active. Using PGR in plants in the right dose can stimulate, change, and inhibit plant growth and development [6,7]. The plants themselves can naturally produce PGR, but often, the PGR produced is suboptimal. Therefore, it is necessary to add PGR as a treatment. Natural ingredients contained in PGR to stimulate plant growth are auxin and gibberellin. Auxin hormone has a function that spurs root development so that the absorption of water and nutrients can be fulfilled. The hormone gibberellin spurs growth on leaves and stems and regulates plant development, namely flowering and fruiting [8,9].

Natural ingredients that can be utilized and easily found by farmers are used as PGR, including shallots. The number of research results that discuss the content and benefits of shallots as PGR as in research that gives PGR shallots in an extract concentration of 20% can increase growth potential, percentage of plumula appear, and soybean plant height [10]. The research results from [9] show that using onion extract can really affect shoot growth, leaf length, and number of leaves of *Aquilaria malaccensis* stems with the best concentration of 40%. Extracts from shallots significantly affected the height parameters of lime plant shoots at the age of 6 WAP (weeks after planting) plants with a concentration of 75% extract from shallots[11].

The results of previous research can be used as a reference and support in using other types of onion varieties, such as red onions. Red onions are often used as a staple or seasoning in daily dishes. Red onions include horticultural plants with a relatively fast growth process because of the growth regulators they contain. Red onions have several ingredients, such as essential oils, methylanine, cycloaline, flavonglycosides, dihydroaline, saponins, quercetin, vitamins, peptides, starches, and phytohormones [12], [13]. Red onions also contain vitamin B1 in thiamin, phytohormones in auxin, and gibberellin hormones found in every type of onion. This compound has a function to facilitate the metabolism of plant tissues in the form of bud growth and is a bactericidal and fungicide [14]. Apart from being an additional ingredient in cooking, the content contained in red onions can be an alternative natural ingredient used as an innovation in utilizing red onions as the main ingredient in making PGR red onion extract.

There is a positive relationship in the addition of PGR, which has a very active role in every process of cell division and elongation and various kinds of anabolism processes in the plant body, thus affecting plant growth. The study aimed to determine the response of ZPT red onion extract with media composition to the growth and production of mustard plants.

RESEARCH METHODS

The study was conducted in July – August 2023. Planting, maintaining, and monitoring growth and production are carried out in Pohjentrek, Pasuruan City. The ingredients used are red onions 10 kg, mustard plant seeds, 96% ethanol, water, soil, manure, and husk charcoal. The tools needed are a blender, oven, knife, polybag, 100 mesh sieve, ruler, and a digital scale.

This research procedure includes making red onion extract using the maceration method. Five hundred grams of red Bombay powder was soaked in 96% 1:5 ethanol solvent for 24 hours. A mixture of ethanol and red onion powder is filtered to obtain filtrate and residue. The red onion extract filtrate is evaporated with a vacuum rotary evaporator until a thick extract is obtained[15]. Then, the mustard plants are in the seedling tray for 7 days or after the fourth leaf appears.

The results of mustard seedlings are placed in polybags containing a mixture of soil, husk charcoal, and manure using the first ratio of 1: 1: 2 and embassy 1: 2: 1. Application of PGR by watering on planting media. The volume of PGR used was 5 mL in each plant and carried out once a week with a combination of T0 = without PGR, T1 = PGR 10% (10 g of red onion extract dissolved with the addition of aquades to the limit mark of the measuring pumpkin of 100mL), T2 = PGR 20% (20 g of red onion extract diluted with the addition of aquades to the limit mark of the measuring pumpkin of 100mL), T3 = PGR 30% (30 g

of red onion extract dissolved with the addition of aquades to the limit mark of a measuring flask of 100mL). Maintenance is carried out by watering in the morning.

Observation of mustard plant growth parameters is carried out by measuring the height of mustard plants starting on the surface of the planting medium to the highest point of growing mustard plants using a ruler measuring instrument, measuring the width of the widest leaves using a ruler. The plant height and leaf width parameters were observed every 1 week from 14 to 42 days after planting (DAP). The wet biomass of mustard plants was weighed with a digital balance at the end of the observation period.

The research data obtained were analyzed using the IBM Statistics SPSS 25 program, tested using the two-way ANOVA test, and continued with the Honest Real Difference (BNJ) test at 5%.

RESULTS AND DISCUSSION

The study was conducted to know and understand the effect of using red onion extract with a combination of planting media composition on growth with observation parameters of plant height (Table 1.), leaf width (Table 2.), and production parameters, namely plant wet biomass (Table 3.).

Based on the results of variety analysis, it was found that in a single factor of treatment of various concentrations of PGR, red onion extract contained in auxin and gibberellin hormones had a significant effect in accelerating plant growth and production, both from plant height, leaf width, and plant wet biomass. A single factor in the composition of the growing medium significantly affects plant height parameters starting at the age of 35-42 DAP and plant wet biomass. The interaction between the PGR concentration of red onion extract and media composition significantly influences production parameters, namely plant wet biomass. This happens because it is influenced by environmental factors, including temperature, humidity, light, and how to apply PGR[16].

The observations in this study are growth parameters in the form of plant height, leaf width, and plant wet biomass. The effect of PGR administration of red onion extract and media composition on growth parameters in the form of plant height is listed in Table 1.

Based on Table 1 data, it was found that from a single factor of treatment, various concentrations of PGR had a significant effect on the height of mustard plants. The PGR effect begins when the plant is 21-42 DAP. This is because the auxin content in red onion extract absorbed by mustard plant tissue can activate energy in food reserves and increase the process of division, elongation, and cell differentiation so that stem elongation is formed in mustard plants [17]. The content of the hormone auxin in DAP red onion extract gives a very fast response, especially in plant growth. The auxin hormone mostly affects the process of cell elongation division and differentiation of the xylem

and phloem tissue so that it affects the stem or roots of plants [18]. The application of growth-regulating hormones in the form of auxin hormones contained in red onion extract can control the development of meristem tissue, thus affecting the cell elongation process, which is the most important component in plant growth [18].

The composition factor of the growing media used has a real effect on the age of plants 35-42 DAP. The interaction of PGR and planting media composition factors has no real influence on plant height parameters. The PGR treatment that gives the highest value is obtained at a concentration of 30% with a value of 23 cm. The treatment of media composition with the highest value was obtained at 1: 1: 2 treatment with a value of 22.69 cm.

The application of various concentrations of PGR and the combination of media composition to the parameters of mustard leaf width is listed in Table 2.

Based on Table 2 data. It was found that the combination treatment of media composition did not have a significant effect but had a significant effect on the treatment of various concentrations of natural PGR on leaf width. There was no interaction in either treatment (natural PGR concentration and media composition). The largest leaf width was obtained when applying PGR red onion extract with a concentration of 30% of 7.50 cm and a media composition of 1: 1: 2, 6.97 cm.

Table 1. The average height of mustard plants after administration of various concentrations of PGR and a combination of media composition

Extract Concentration	Average Plant Height (cm)				
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
T0	2.73 ^a	4.38 ^a	5.81 ^a	12.63 ^a	19.00 ^a
T1	3.56 ^a	5.56 ^{ab}	6.88 ^{ab}	14.56 ^{ab}	20.75 ^{ab}
T2	3.81 ^a	5.63 ^{ab}	8.25 ^{bc}	15.05 ^b	22.38 ^b
T3	3.62 ^a	6.44 ^b	9.63 ^c	15.69 ^b	23.00 ^b
Media Composition	Average Plant Height (cm)				
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
1:2:1	3.58 ^a	5.31 ^a	7.63 ^a	13.30 ^a	19.88 ^a
1:1:2	3.38 ^a	5.69 ^a	7.66 ^a	15.66 ^b	22.69 ^b

Description: Values followed by the same letter show no real difference in the 95% BNJ test.

Table 2. The average width of the leaves of mustard plants after administration of various concentrations of PGR and the combination of media composition

Extract Concentration	Average Leaf Width (cm)				
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
T0	0.86 ^a	1.21 ^a	1.88 ^a	4.38 ^a	5.94 ^a
T1	1.00 ^{ab}	1.43 ^{ab}	2.00 ^a	4.93 ^{ab}	6.63 ^{ab}
T2	1.00 ^{ab}	1.54 ^{ab}	2.38 ^{ab}	5.31 ^{ab}	7.13 ^b
T3	1.06 ^b	1.81 ^b	2.75 ^b	5.88 ^b	7.50 ^b
Media Composition	Average Leaf width (cm)				
	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
1:2:1	0.96 ^a	1.48 ^a	2.25 ^a	4.99 ^a	6.63 ^a
1:1:2	1.00 ^a	1.52 ^a	2.25 ^a	5.25 ^a	6.97 ^a

Description: Values followed by the same letter show no real difference in the 95% BNJ test.

The application of various concentrations of PGR and the combination of media composition to the wet biomass of mustard plants is listed in Table 3.

Based on Table 3 data. It was found that the PGR concentration treatment of red onion extract and

the combination of media composition had a significant effect on the wet biomass of mustard plants, and there was an interaction between the two treatments. The wet biomass in the control treatment has the lowest biomass and will increase as the amount

of PGR concentration given increases. The largest plant wet biomass was obtained at a concentration of 30%, weighing 80.88 g, and in the composition of the medium obtained at 1:1:2 treatment weighing 60.75 g.

Table 3. Wet biomass of mustard plants after administration of various concentrations of PGR and media composition combonisai

Extract Concentration	Basah biomass (g)
T0	22.13 ^a
T1	55.88 ^b
T2	67.25 ^c
T3	80.88 ^d
Media Composition	Basah biomass (g)
1:2:1	52.31a
1:1:2	60.75b

Description: Values followed by the same letter show no real difference in the 95% BNJ test.

Based on the results of various fingerprints from Table 1, the treatment of various concentrations of PGR red onion extract had a very real effect on the growth process of mustard plants. It can be seen that every week of observation, the height of mustard plants increases with the age of the plant in each treatment. In the control treatment, the height of plants aged 42 DAP gave the lowest value of 19.00 cm compared to the height of plants with 30% PGR treatment, which gave the highest yield of 23.00 cm. Table 2. shows the results of fingerprinting various leaf width parameters on the implementation of various concentrations of PGR red onion extract. The control treatment at 42 DAP had a lower leaf width value of 5.94 cm compared to the highest leaf width produced by the 30% PGR treatment of 7.50 cm. The parameters of plant wet biomass are in Table 3. There was a noticeable difference between the three PGR combinations of red onion extract and the control treatment. Treatment with a PGR concentration of 30% gave the highest average wet biomass of mustard plants of 80.88 g. Based on the observation parameters, it was found that applying PGR red onion extract at a concentration of 30% was the best treatment regarding the parameters of leaf width, plant height, and wet biomass of mustard plants.

PGR extract from red onions contains PGR, which can stimulate the growth of buds and plant root processes. Red onion extract contains vitamin B1 in the form of thiamin, which is found in each type of onion. This compound has a function to facilitate the metabolism of plant tissue in the form of shoot growth and is a bactericidal and fungicide [14]. Red onion extract has a hormone compound in the form of endogenous auxin obtained from layered bulbs in red onions. In the layer tubers, prospective young shoots

can produce phytohormone compounds, namely auxin hormones, in the form of IAA (Indole Acetic Acid)[19]. The hormone auxin itself is very important in plant growth, namely in enlargement. Division and elongation of cells can thus help stimulate root growth. In addition, the hormone auxin can affect the metabolic process of nucleic acids and the plant's metabolism [20]. In addition to the hormone auxin, red onions also contain phytohormones in the form of gibberellin. The gibberellin hormone has a function to stimulate the growth process of leaves and stems. The effects of gibberellins also participate in the regulatory process of plant development, such as the hormone auxin [8], [21].

Using PGR red onion extract can increase the growth rate of mustard plants. This is because the addition of PGR can support the roots of mustard plants in optimally absorbing water and nutrients, increasing plant height, leaf width, and wet biomass of mustard plants. This is supported by the results of research [22], which states that the increase in the concentration of PGR can support plants in absorbing various nutrients to help the process of plant photosynthesis, which affects the increase in the growth of mustard plants. Using PGR red onion extract containing hormones such as auxin and gibberellin can increase the ratio of hormone content in plant tissue so that plant needs are met, and plant growth rates can increase on all observation parameters [23]. Not only that, the content of the hormone auxin in PGR red onion extract provides a very fast response, especially at plant height. This is because the hormone auxin affects most of the cell elongation process, both in the stem and roots of the plant [17].

The composition of the media is the result of mixing various types of materials that can meet the requirements, including being able to bind water in the media, having porous properties so that puddles do not occur in flush water, not having toxic properties for plants, and containing enough nutrients needed by plant growth [24]. The composition of the selected media includes soil, husk charcoal, and manure mixed using a ratio of 1: 2: 1 and 1: 1: 2.

The results of the fingerprints of Table 1 show that treatment with a combination of media composition significantly affects plant height parameters starting at age 35-42 DAP. The height of mustard plants at 42 HST was obtained at a media composition of 1: 1: 2 of 22.69 cm. Table 2. It shows that the combination of media composition does not significantly affect leaf width with each plant age. The greatest leaf width was obtained in the combination treatment of 1:1:2 of 6.97 cm. Results from fingerprint data analysis Table 3. Showing the results of the combination of compositions can significantly affect the wet biomass meters of mustard plants. Mustard plants at the age of 42 DAP obtained the greatest weight in a combination of 1: 1: 2 planting media with a size of 60.75 g. This shows that the composition of 1: 1: 2 media is the best treatment for mustard plants at

plant height parameters aged 35-42 HST and plant wet biomass. Using more manure can provide nutrients for plants through micro and macronutrients, but not manure can improve water absorption in the soil caused by high fiber levels in cellulose [25]. The high nitrogen content in manure organic matter and the adequacy of P and K elements provide an increase in vegetative growth and stimulate the development process of leaves and stems for optimal growth. The development of leaves and stems can be seen from plant height, leaf width, and plant wet biomass [26,27]. When compared with the composition of 1:2:1 media (soil: husk charcoal: manure), which produces lower values due to the porous nature of husk charcoal, which causes the suspicion of mustard plants experiencing water shortages, so that during the growth process, it affects cell turgor which inhibits the process of cell development, cell wall synthesis, and protein [28].

The results of research that has been conducted show that the use of manure with a larger ratio in the composition mixture as a planting medium can produce better growth in mustard plants. This is closely related to factors that affect the growth process, including the use of organic matter and the availability of sufficient nutrients. Using media composition with a ratio of 1:1:2 (soil: husk charcoal: manure) has the best influence on plant height parameters and wet biomass of mustard plants. The use of manure in a mixture of planting media is thought to be one of the influencing reasons because manure has undergone a complete decomposition process, which results in the nutrient content being fulfilled faster. Manure contains essential macro and micronutrients during plant growth [29].

The interaction between the PGR concentration of red onion extract and the composition of the growing medium had a significant effect on the wet biomass of mustard plants. However, there was no noticeable effect on plant height and leaf width. This is in line with the assumption [29] which suggests that the use of PGR can increase growth in plants caused by the hormone auxin, which occurs by starting at the roots to the shoots with the formation of leaves so that the process of photosynthesis will increase in line with the time of growth. The use of a mixture of soil and manure as the composition of the planting medium will affect the improvement of planting physical properties (wet biomass) and chemical properties of the soil.

CONCLUSION

The study results found that extracts from red onions can be used as an alternative ingredient for natural growth regulators to accelerate the division and enlargement of mustard plant cells. Not only that, the comparison of the composition of the planting medium between soil, husk charcoal, and appropriate manure can also meet the needs of nutrients and macro micro elements of mustard plants. It can be seen from the results of research that has been conducted that the use of PGR red onion extract with a concentration of 30%

has a very real effect and provides the best results on the parameters of plant height, leaf width, and plant wet biomass. The combination of composition in planting media consisting of soil, husk charcoal, and manure in a 1: 1: 2 ratio can increase plant height at the age of 35-42 DAP and wet biomass of mustard plants. The interaction between the PGR concentration of red onion extract and media composition significantly affected the wet biomass of plants but not the plant height and leaf width of mustard plants.

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