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EFFECTIVENESS TEST OF PLANT GROWTH REGULATOR (PGR) ON GROWTH AND PRODUCTION OF RED ONION (*Allium ascalonicum* L.).

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ABSTRACT

Efforts to increase onion production are faced with higher prices of chemical fertilizers and residues in the soil. The growth regulator is a non-nutrient organic compound that in low concentration can encourage, inhibit or qualitatively alter the growth and development of the plant. PGR applications in plants may affect the orientation of asymilat transport, senator delays and cell enlargement. The effect of PGR application on a plant will be obvious if the condition of the plant is healthy, nutrient needs are met and good maintenance. The aim of this research is to get PGR from sweet corn, pulut corn, yellow corn, and white corn that can increase the growth and production of one of red onion plant varieties. The results showed that sweet corn PGR showed significant result both growth component and production component of onion plant. And red onion that has high production is red onion of Bima Brebes varieties.

Keywords: *sweet corn PGR, pulut corn PGR, yellow corn PGR, white corn PGR, red onion*

INTRODUCTION

In Indonesia, red onion (*Allium cepa* L.) is a commodity that is very important vegetable crops. Needs red onion in Indonesia for 5 years (2010-2014) average of 0.72 million ton/year while the average production of red onion in the same year only reached 0.6652 million tons of tubers (BPS, 2015; BSK, 2015).

National onion production is not sufficient demand and domestic consumption, so the government took measures inport onion in the same year, an average of 0.07 million ton/year (9.16%) (PBS, 2015; BSK, 2015). Therefore onion production must be increased in order to attain self-sufficiency onion announced by the government. Efforts to increase onion production are faced with higher prices of chemical fertilizers and residues in the soil.

Plants are naturally already contains a growth hormone called endogenous hormones. However, this hormone affects less optimum vegetative and reproductive growth processes of plants. The addition of plant growth regulator (PGR) is often perfor-med to optimize the vegetative and reproductive growth of plants, for example gibberellin (GA) who is able to accelerate the growth and flowering (Abidin 1985 ***in*** Siti Komariyah *et al*., 2012).

Giberelin able to accelerate flowering plants through gene activation floral meristem to produce proteins that induce the expression of genes forming flower organs (such korolla, Kalix, stamen, and pistillum) (Arika *et al.*, 2009). Auxin is a plant hormone that can regulate many physiological processes, such as growth, division and differentiation of cells and protein synthesis (Darnell *et al.*, 1986).

According Ulfa (2014), the plant extract provides plant growth and production of potato mini tubers better than synthetic PGR applications (2,4D and NAA) (Simair *et al.*, 2013). as well as water and corn seed extract at a concentration of PGR giberelin 41.23 ppm; auxin 1.67 ppm; and cytokinins equivalent to 53.94 ppm gibberellin compareson: auxin: cytokinin (25: 1: 32), giving growth of seed potatoes and the best mini tuber production.

According Khalimi and Gusti, (2009), a certain concentration of plant hormones such as acid indole acetic (IAA), cytokinin, ethylene and gibberellic acid in the plant can improve plant growth (Woranan *et al*., 2014) in plant growth, control techniques have is considered an environmentally friendly sustainable agriculture and reduce the use of synthetic agrochemical inputs, (Suherah *et al.*, 2018), PGR can be used in agriculture, especially in efforts to increase food production and improvement of environmental quality.

MATERIALS AND METHODS

Place and time: Research conducted at the Experimental Farm STIP Prima Sengkang, conducted in December 2016 until May 2017.

Materials and Equipment: Materials used in this study are three varieties of onion plants (varieties Bima Brebes, varieties of headers and varieties Super Philip), sweet corn PGR, pulut corn PGR, yellow corn PGR, and white corn PGR, distilled water, urea, SP36, KCl fertilizer, NPK fertilizer and organic fertilizer.

The Equipment used are scales electric meter, roll-meter, hoes, hand tractor mini (raised bed), hand sprayer semi-automatic, knapsack sprayer semi-automatic, Dinamao water pumps, measuring cups (size 20 ml), PLN, Sprinklers, springkel eight set, sickles, machetes, hoes, labels, camera, and stationery.

Analysis Method: This research used split plot design (SPD) method with three varieties of shallot plant (Bima Brebes variety, Tajuk variety and Super Philip variety) as main plot (PU) (symbol "v") consist of 3, among others: varieties of Bima Brebes (v_1), Tajuk varieties (v_2), and Super Philip varieties (v_3). Subsequently four PGR extracts (sweet-corn, corn, yellow corn and white corn) plus one without PGR extract as Plot Child (AP) (symbol "z"), consisted of 5, among others: without extract PGR (z_0), sweet corn PGR (z_1), pulut corn PGR (z_2), yellow corn PGR (z_3), and white corn PGR (z_4).

The treatments contained 15 combinations (3 PU x 5 AP) and each treatment combination was repeated 3 times, so the number of treatment combinations was 45 (15 x 3). Furthermore, each treatment combination was planted in each plot that had been prepared with a size of 1 x 1 m^2, and spacing of 10 x 20 cm^2, so it takes a plot of 45 plots, as a research unit.

Implementation Stages: Preparation of planting with minimum soil treatment includes cleaning of weeds and other weeds that grow around the land using sickles, machetes, and or hoes. The first cultivation was done two weeks before planting, one week later followed by light processing using mini hand tractor for making plots as well as organic fertilizer 2,000 kg / ha (200 g / m^2), the number of plots for one group of 15 fruit, there are three groups then the plot number is all 45 plots with the size of each plot of 1 m x 1 m, the distance between plots 50 cm and the distance between groups 100 cm, so it takes an area of 168 m^2 (24 m x 7 m) (including each 1 m outside the research unit).

The seeds used are varieties of Bima Brebes, varieties of Tajuk, and Super Philip varieties. Before planting red onion bulbs first cut the tip 1/3 part, then watered with a solution Biopestisida Antagonis (Dithane M-45) to avoid pests and diseases of red onion plants.

After the plot is finished and ready for planting, the planting is done by way of approximately 3 cm (adjustable tuber size), with a spacing of 10 cm x 20 cm. Each planting hole is filled with shallot 1 tubers, to obtain regular rows of planting used rope rapia each have been marked according to spacing used.

Red onion fertilization of 400 kg / ha ZA, 700 kg/ha NPK Mutiara, and 2,000 kg/ha Organic Fertilizer (PT Petrokimia Gresik., 2017). Provision of fertilizer is done when the plants are age 15 days after planting (dap) as much as 50% ZA and 50% NPK, Provision of fertilizer next at the age of the plant 30 days after planting. Maintenance consists of weeding, water regulation, and pest control.

PGR treatment was administered at the age of 15 and 30 days after planting (DAP), after fertilizer application. Each PGR extract was sprayed with a dose of 400 ml / ha at a concentration of 1 ml / liter of water, in each clump of plants evenly, based on the treatment of the randomization results.

Processing of measurement data in the field through Exel 2013 Program, Further, analyzed by using SPSS 18, if the result of Analysis of Variance (ANOVA), showing significantly, it will be done Duncan Multiple Area Test Analysis at 5% level (Gaspersz, 1991)

The observational component consists of growth components: Plant height, plant leaves. And components of production: diameter of sample bulbs and production per hectare.

RESULTS AND DISCUSSION

Growth Components

Plant Height (cm): The results showed that the analysis of variance on the red onion plant height 14, 21, 28, 35, and 42 days after planting (DAP) showed very significant effect on PGR treatment (AP). On the other hand, treatment of red onion varieties (PU) and interaction between PU x AP has no significant effect on all plant height parameters (Figure 1 and 2).

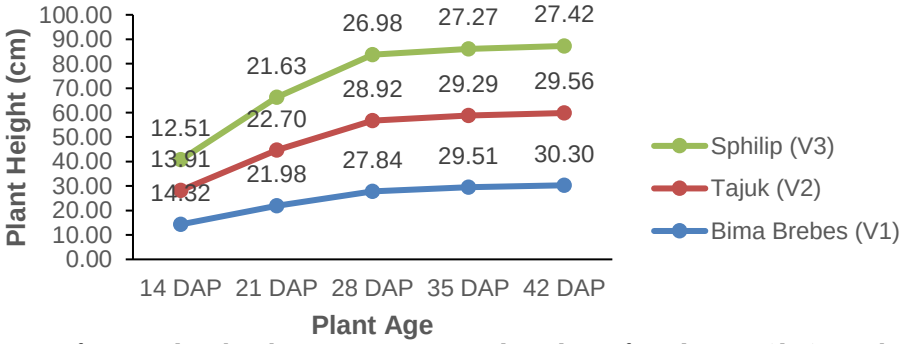

Figure 1: Mean of onion plant height 14, 21, 28, 35, and 42 days after planting (dap), on the treatment of onion varieties (cm).

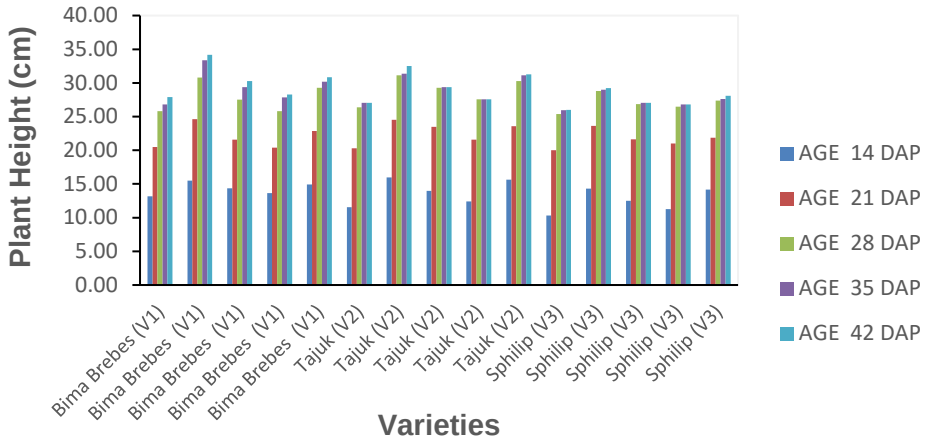

Figure 2: Mean of onion plants height 14, 21, 28, 35, and 42 days after planting (dap), on the treatment of PGR interaction with onion varieties (cm).

Results of Duncan's multiple range test (Duncan), showed that the sweet corn plant growth regulator (z_1) significantly different treatments pulut corn PGR (z_2), yellow corn PGR (z_3), and without PGR (z_0). However, no significant effect with white corn plant growth regulator treatment (z_4), plant height 14, 21, 28, 35 and 42 DAP (Table 1).

Table 1: Results of Duncan test on mean high of onion plant height 14, 21, 28, 35, and 42 days after planting (dap), on the treatment of PGR (cm).

Plant height	Plant Growth Regulator (PGR)					*Duncan test at 5 % level*
	z0	**z3**	**z2**	**z4**	**z1**	
Age 14 dap	11.69	12.42	13.60	14.91	15.26	1.48
						1.56
						1.60
						1.63
Age 21 dap	20.27	21.00	22.23	22.76	24.25	1.61
						1.69
						1.74
						1.78
Age 28 dap	25.85	26.60	27.88	28.97	30.25	1.81
						1.91
						1.96
						2.00
Age 35 dap	26.59	27.40	28.60	29.63	31.23	1.58
						1.66
						1.71
						1.75
Age 42 dap	26.98	27.53	28.91	30.07	31.96	1.58
						1.66
						1.70
						1.74

Description: middle value followed by underscore, different not significant on Duncan test at 5% level

The measurement results red onion plant height at 14, 21, 28, 35 and 42 days after planting (DAP) real effect on plant growth regulator (AP). Plant growth regulators of sweet corn of plant height showed the highest red onion 31.96 cm, while the lowest in the treatment without PGR is 26.98 cm. This is due to the content of PGR of sweet corn is higher compared to other treatments.

According to Abidin 1985 ***in*** Siti Komariyah *et al.*, (2012) and Idhan A., (2016), gibberellin (GA) to accelerate the growth, (Darnell *et al.*, 1986) Auxin is a plant hormone that can regulate many physiological processes, such as growth, division and differentiation of cells and protein synthesis.

PGR applications in plants can affect the transport orientation assimilate, delays senensen and cell enlargement (Wattimena, 1988 *in* Amraini and Sugiyanta, 2008). (Ulfa, 2014), plant growth potato mini tubers very well with natural plant growth regulator application, (Simair *et al.*, 2013).

According Khalimi and Gusti (2009), a certain concentration of plant hormones such as indole acetic acid (IAA), cytokinin, ethylene and gibberellic acid in the plant can improve plant growth. Auxin plays a role in growth to spur the process of cell elongation, (Zhao, 2008; Zhao, 2010; Andrzej and Alicja 2009) the formation of lateral roots and fibrous root cause water and mineral absorption processes can run optimally.

Treatment of various varieties of red onion and interaction showed no real effect (Figure 1 and 2). It is caused by genetic factors plants. However, the variety and interaction between varieties bima with sweet corn PGR, still exhibit high average crop better than others. In line with the opinion of the Sadjad ***in*** Idhan (2016), that the power difference between the varieties grown are determined by genetic factors.

Plant Leaves (strands): The results showed that the analysis of variance on the leaves of onion plants 14, 21, 28, 35, and 42 days after planting (DAP) shows results very significant effect on the treatment of PGR (AP). While the treatment of onion varieties (PU) and the interaction between (PU x AP) effect is not real at all the parameters of the leaves of plants (Figure 3 and 4).

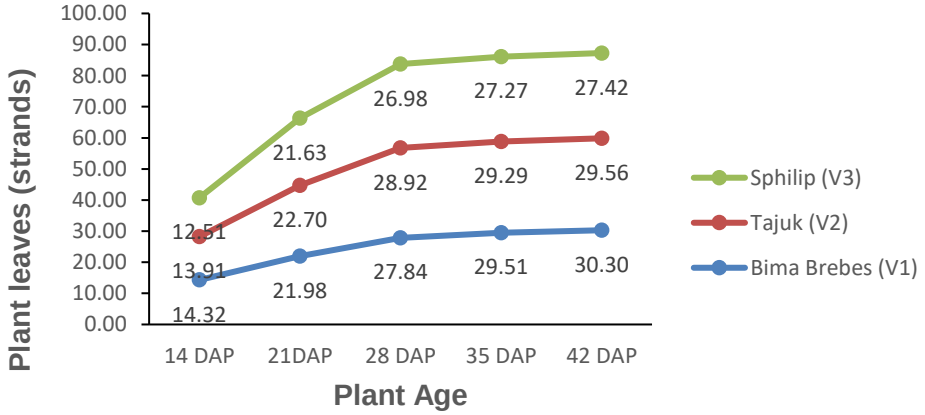

Figure 3: Mean of onion plants leaves 14, 21, 28, 35, and 42 days after planting (dap), on the treatment of onion varieties (strands).

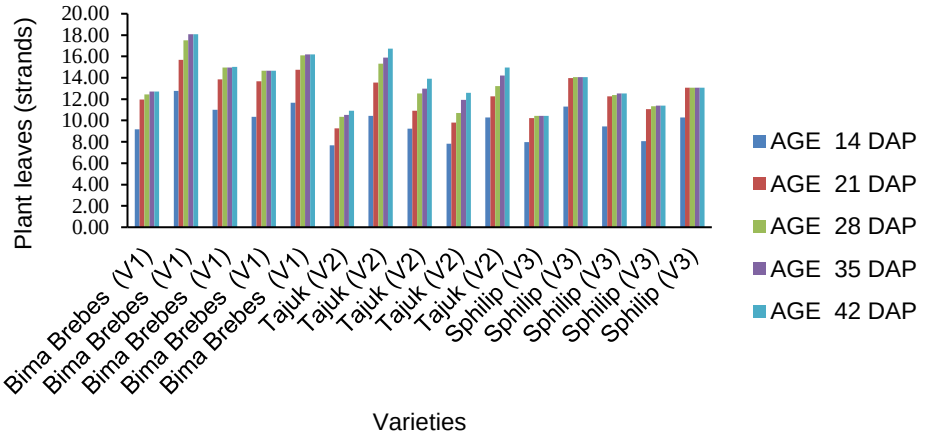

Figure 4: Mean of onion plants leaves 14, 21, 28, 35, and 42 days after planting (dap), on the treatment of PGR interaction with onion varieties (strands).

Results of Duncan's multiple range test (Duncan), showed that the sweet corn plant growth regulator (z_1) significantly different treatments pulut corn PGR (z_2), yellow corn PGR (z_3), and without PGR (z_0). However, no significant effect with white corn plant growth regulator treatment (z_4), on plant leaves 14, 21, 28, 35 and 42 DAP (Table 2).

Table 2: Result of Duncan test on mean leaf of onion plant leaves 14, 21, 28, 35, and 42 days after planting (dap), on the treatment of PGR (strands).

Plant Leaves	Plant Growth Regulator (PGR)					*Duncan test at 5 % level*
	z_0	**z_3**	**z_2**	**z_4**	**z_1**	
Age 14 dap	08.27	08.74	09.89	10.75	11.51	1.24
						1.30
						1.33
						1.36
Age 21 dap	10.48	11.52	12.35	13.36	14.39	1.21
						1.27
						1.31
						1.33
Age 28 dap	11.07	12.23	13.28	14.14	15.64	1.67
						1.76
						1.80
						1.84
Age 35 dap	11.22	12.67	13.50	14.49	16.01	1.65
						1.73
						1.78
						1.82
Age 42 dap	11.36	12.89	13.83	14.74	16.30	1.78
						1.88
						1.92
						1.97

Description: middle value followed by underscore, different not significant on Duncan test at 5 % level

The observation of the leaves of red onion crop at 14, 21, 28, 35 and 42 days after planting (DAP) real effect on plant growth regulator (AP). Plant growth regulators from sweet corn leaves red onion plants showed high of 16.30 strands, while the lowest in the treatment without PGR which strands 11, 36. This is due to the content of PGR of sweet corn is higher compared to other treatments.

According to the application of PGR in the plant can affect the orientation of the transport of assimilates, delays senesen and cell enlargement (Wattimena, 1988 *in* Amraini and Sugiyanta (2008). Effects PGR applications on a plant would be obvious if the conditions of a healthy crop, nutrient needs are met, and maintenance well. the increase in the concentration of cytokinin in the leaves is one of the hormonal phenomena are important for flower induction. (Ryugo, 1990; Ahmed, 2017).

According to Turnbull *et al.*, (1996 ***in*** Siti Komariyah *et al.*, 2012) that contains a high giberelin will spur cell division and elongation in shoot apex, especially in the meristematic cells, thus stimulate vegetative growth.

Treatment of various varieties of onion and interaction showed no real effect (Figure 3 and 4). It is caused by factors of adaptability of plants. However, the variety and interaction between varieties bima with sweet corn PGR, still shows the average of the leaves of plants is higher than the others. In line with the opinions Jumin (2005), that the plant will undergo physiological and morphological changes in the direction corresponding to the growth environment.

Production Components

Sample Diameter At Harvest (cm): The results showed that the analysis of variance diameter sam-

ple of red onion crop at harvest age of 70 days after planting (DAP) shows results very significant effect on the treatment of PGR (AP). While the treat ment of red onion varieties (PU) (Figure 5) and the interaction between PU x AP influential not evident in all parameters of the sample diameter at harvest (Figure 6).

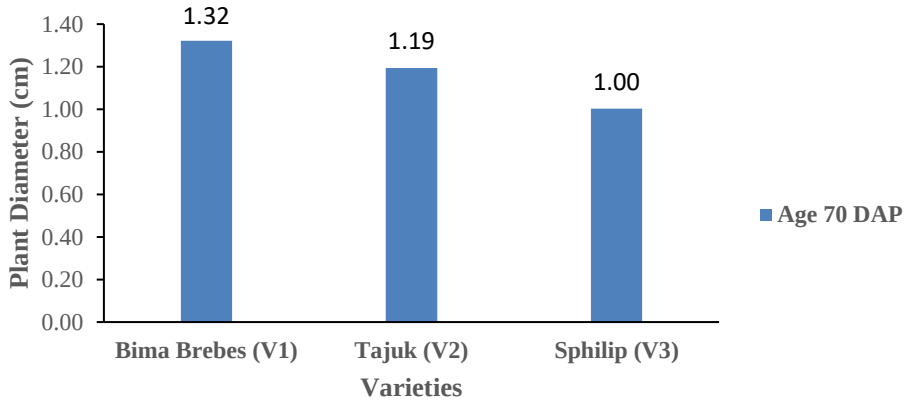

Figure 5: Mean of sample diameter on during harvest, onion plant 70 days after planting (dap), on the treatment of onion varieties (cm).

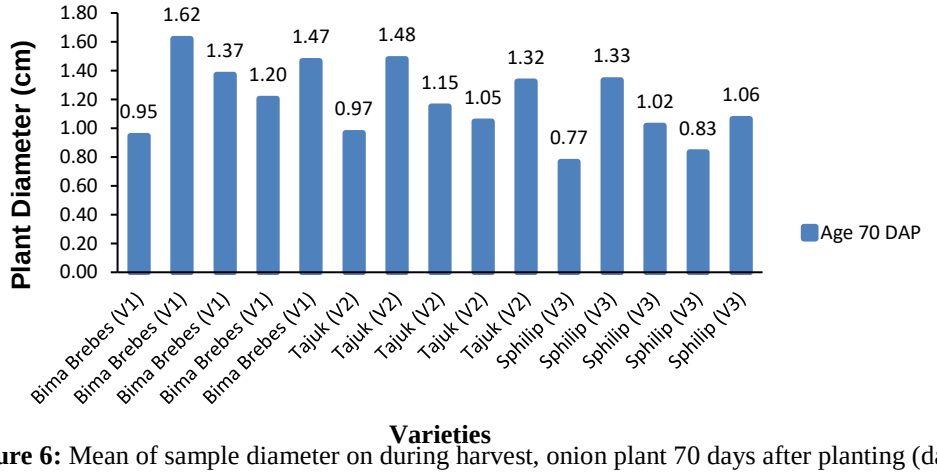

Figure 6: Mean of sample diameter on during harvest, onion plant 70 days after planting (dap), on the treatment of PGR interaction with onion varieties (cm).

Results of Duncan's multiple range test (Duncan), showed that the sweet corn plant growth regulator (z_1) significantly different from other PGR treatment. While the PGR treatment of white corn (z_4) significantly different from the treatment plant growth regulator yellow corn (z_3) and without PGR (z_0). However, no significant with pulut corn plant growth regulator treatment (z_2), the parameters of the sample diameter of red onion crop at harvest age of 70 days after planting (DAP) (Table 3).

Table 3: Results of Duncan test of mean of sample diameter on during harvest, onion plant 70 days after planting (dap), on the treatment of PGR (cm).

Plant Diameter	Plant Growth Regulator (PGR)					*Duncan test at 5 % level*
	z_0	z_3	z_2	z_4	z_1	
Age 70 dap	0.89	1.03	1.18	1.28	1.48	0.143
						0.150
						0.154
						0.157

Description: middle value followed by underscore, different not significant on Duncan test at 5 % level

The result of measurement of tuber diameter of sample at harvest of red onion crop at age 70 days after planting (DAP) has significant effect on growth regulator (AP). Plant growth regulators of sweet corn root samples showing diameter red onion crop harvest time high of 1,48 cm, while the lowest in the treatment without PGR is 0.89 cm. This is due to the content of PGR of sweet corn is higher compared to other treatments.

According to Zhao, (2008); Zhao, (2010); Andrzej and Alicja, (2009), auxin plays a role in growth to spur the process of cell elongation, the formation of lateral roots and fibrous root cause water and mineral absorption processes can run optimally. Cytokinin is a hormone that plays a role in cell division (cytokinesis) (Zhao, 2008; Zhao, 2010; Kyozuka 2007; Andrzej and Alicja, 2009).

Treatment of various varieties of onion and interaction showed no real effect (Figures 5 and 6). It is caused by environmental factors of plant genetic tumbuhdan. However, the variety and interaction between varieties bima bima with sweet corn PGR, still showed an average diameter larger than others. In line with the opinion of the Sadjad ***in*** Idhan A., (2016), that the power difference between the varieties grown are determined by genetic factors. Jumin (2005), that the plant will undergo physiological and morphological changes in the direction corresponding to the growth environment.

Production per Hectare Age 77 days after harvest (t): The results showed that the analysis of variance production per hectare of onion plants aged 77 days after planting (DAP) shows results very significant effect on the treatment of PGR (AP). While the treatment of onion varieties (PU) (Figure 7) and the interaction between PU x AP effect is not noticeable at all production parameters per plot onion plants aged 77 days after planting (DAP), (Figure 8).

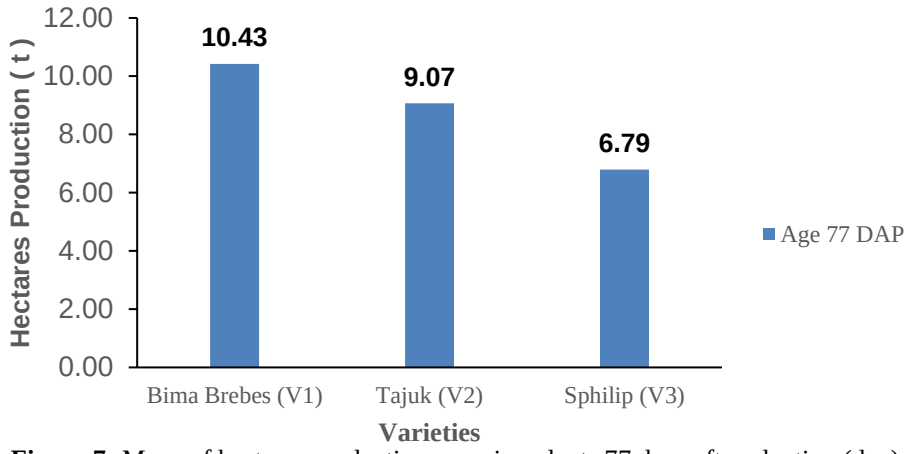

Figure 7: Mean of hectares production on onion plants 77 days after planting (dap), on the treatment of onion varieties (t).

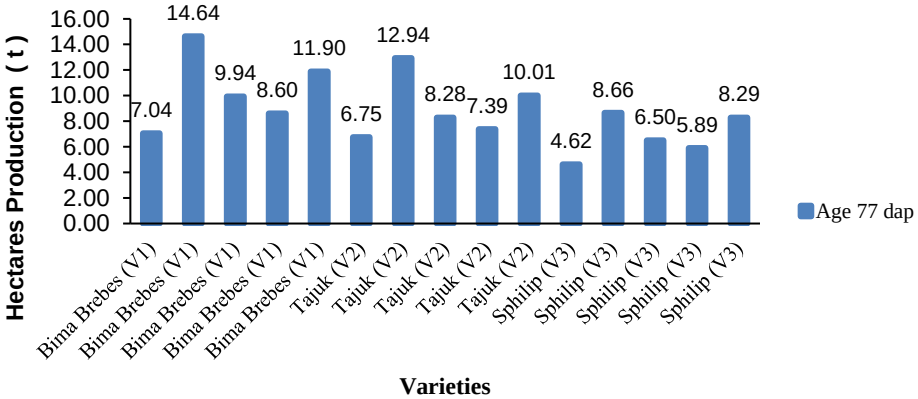

Figure 8: Mean of hectares production on onion plants 77 days after planting (dap), on the treatment of PGR interaction with onion varieties (t).

Results of Duncan's multiple range test (Duncan), showed that the sweet corn plant growth regulator (z_1) significantly different treatments pulut corn PGR (z_2), yellow corn PGR (z_3), and without PGR (z_0). However, no significant effect with white corn plant growth regulator treatment (z_4), on production of red onion plants per plot the age of 77 days after planting (DAP) (Table 4).

The measurement results of production per hectare of onion crop at the age of 77 days after planting (DAP) real effect on plant growth regulator (AP). Plant growth regulators of sweet corn plants per plot shows production of red onion is highest, 12.08 t h^{-1}, while the lowest in the treatment without PGR is 6.14 t h^{-1}. This is due to the content of PGR of sweet corn is higher compared to other treatments.

Table 4: Result of Duncan test of mean on hectare production, onion plant 77 days after planting (dap), on the treatment of PGR (t).

Hectare Production (77 dap)	Plant Growth Regulator (PGR)					*Duncan test at 5 % level*
	Z0	**Z3**	**Z2**	**Z4**	**Z1**	
Age 77 dap	06.14	07.30	08.24	10.07	12.08	2.03
						2.14
						2.19
						2.24

Description: middle value followed by underscore, different not significant on Duncan test at 5 % level

According According Karadeniz *et al.*, (2006); Samse and Tiurmaida, (2006) Giberelin function in the formation of seeds, which stimulate the formation of pollen (pollen), increase fruit size, stimulates flower formation, and ending the seed dormancy period. Giberelin with low concentrations did not stimulate root formation, but at high concentrations will stimulate root formation (Jauhar *et al*., 2013).

Treatment of various varieties of onion and interaction showed no real effect (Figures 7 and 8). It is caused by genetic factors and adaptability of plants, as well as a high factor of endogenous hormone in plants onion, so that administration of exogenous hormone had no effect on the production of red onion. However, the variety and interaction between varieties bima with sweet corn PGR, still shows the average production per hectare which is higher than the other. In line with the opinions Idhan A., (2016), that basically own plant hormone called endogenous hormone.

According to Suwandi *et al.*, (2015), that the other factors that determine the outcome of the onion is genetic and it seems more determined by genetic factors influence differences in varieties than fertilization factors or growth environment management.

CONCLUSIONS AND SUGGESTIONS

Conclusion: 1). PGR of sweet corn showed significant result both growth component and production component of onion plant. 2). Red onion that has high production is red onion of Bima varieties.

Suggestion: 1) It is necessary to conduct a second continuation test of PGR on Bima varieties of red onion to see the optimization of production. 2). Planting location suitable for red onion planting of Bima varieties.

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