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Effect Induction Bio Hormone on Production and Content of Nutritional Substances on Tomato Fruit Variety Cherry Small Fry and Cherry Japan

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Abstract

Food quality could be determined based on the criteria of food security, nutrition content, and trade standard on foodstuffs to food and beverages (Anonymous, 1996). At the stage of production or tomato cultivation system, the treatment accorded aims to increase the quantity and quality of tomatoes such as increased shelf life, organoleptic quality, and nutritional content. The content of the most prominent nutrient in tomatoes are vitamin C and carotene as forming pro-vitamin A. The content of vitamin C and carotene in tomatoes was useful to help the healing process sprue disease and night blindness. This type of research is experimentally using factorial completely randomized design. Factor I: Varieties of tomatoes which consists of two varieties, namely Cherry Small Fry (CSF) and Cherry Japan (CJ) and the second factor is the addition bio hormone i.e. non-induction bio hormone (B0) and induction bio hormone (B1). Each treatment was repeated 3 times so that overall there are 12 experimental units. Duncan test showed the CJ tomato induced growth hormone has the highest production with the average amount of 2449.10 grams. CJ tomato non-induced growth hormone has the lowest moisture content with the amount of 89.84%. CJ tomato induced growth hormone has the highest vitamin C levels with the average number of 133.07 mg / 100 g. CSF tomato non-induced growth hormone has the highest carotene content with average number 15297.09 ug / 100 g. Induction of growth hormone on tomato plants can increase the amount of production, with a high vitamin C content and low moisture content. Suggested tomato varieties to be developed is the Japanese Cherry tomato varieties (CJ) compared Cherry tomatoes Small Fry (CSF).

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1. Introduction

Quality can be determined based on the criteria of food security, nutrition content, and trade standard on foodstuffs to food and beverages (Anonymous, 1996). Tomatoes are generally consumed in the form of fresh or processed. At the stage of production or tomato cultivation system, the treatment accorded aims to increase the quantity and quality of tomatoes such as increased shelf life, organoleptic quality, and nutritional content. The content of the most prominent nutrient in tomatoes are vitamin C and carotene as forming pro-vitamin A. The vitamin C and carotene in tomatoes is useful to help the healing process sprue disease and night blindness. Tomatoes also contain lycopene and fiber that serves to reduce the levels of LDL (Low-Density Lipoprotein) in the blood (Wiryanta and Wahyu, 2002). Tomato cultivation system to increase productivity also experienced a shift from the conventional system into a system of cultivation using plastic mulch or with a hydroponic system. Culture systems to increase production also followed by the use of biotechnological processes such as the use of growth hormone to stimulate plant growth and development, so that the plant cells are stimulated to cell division and differentiation.

Growth hormone often used to stimulate plant growth and development include auxin, gibberellins, and cytokinins. This hormone formulations can be added with various vitamins such as thiamin, pyridoxine, nicotinic acid and mineral types. Plant growth regulator auxin, gibberellins, and cytokines work synergistically in the plant that is characterized by the development of plants. Plant growth regulators are given on potato simultaneously indicate a rapid shoot growth in the development of the potato plant stolen. At certain concentrations of Plant growth regulator can support or inhibit cell division, which plays a role in the growth and development of plants so that the plants remain healthy (Danoesastro, 1976; Salisbury and Ross, 1995).

In Hawaii ever made use of gibberellins to increase sugar cane and sugar production, increase production and crispness on celery plants, and the cause of wine grape plants resistant to fungal infections (Salisbury and Ross, 1995; Anonymous, 2004). Research that examines the influence of hormones and minerals to fruit quality characteristics, such as in tomatoes has not been done. This study aimed to determine the effect of growth hormone on the production, moisture content, vitamin C and carotene content of tomato fruit varieties Cherry Small Fry and Cherry Japan.

2. Materials and Methods

This type of research is experimentally using factorial completely randomized design. Factor I: Varieties of tomatoes which consists of two varieties, namely Cherry Small Fry (CSF) and Cherry Japan (CJ) and the second factor is the addition bio hormone ie non-induction bio hormone (B0)and bio hormone induction (B1). Each treatment was repeated 3 times so that overall there are 12 experimental units (Heryanto, 1996). Bio hormone is given to the treatment group one week after planting on polybags and hereafter is given once every week at a dose of 2 ml per plant for 5 months.

Figure 1. Cherry Small Fry

Figure 2. Cherry Japan

3. Results and Discussions

Based on the Shapiro-Wilk test all of the data showed normal distribution because of the significant value> 0.05 (p> 0.05). (Table 1). The statistical test followed by a parametric test that is One Way Anova.

Table 1
Normality Test Data with the Shapiro-Wilk test

Variables	Treatment	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
Production	Induction CSF	.204	3	.	.993	3	.845
	Non Induction CSF	.176	3	.	1.000	3	.988
	Induction CJ	.198	3	.	.995	3	.871
	Non Induction CJ	.360	3	.	.809	3	.135
Moisture Content	Induction CSF	.369	3	.	.788	3	.087
	Non Induction CSF	.290	3	.	.926	3	.474
	Induction CJ	.349	3	.	.832	3	.194
	Non Induction CJ	.177	3	.	1.000	3	.961
Vitamin C	Induction CSF	.177	3	.	1.000	3	.967
	Non Induction CSF	.354	3	.	.821	3	.166
	Induction CJ	.335	3	.	.859	3	.264
	Non Induction CJ	.370	3	.	.786	3	.082
Carotene	Induction CSF	.371	3	.	.784	3	.077
	Non Induction CSF	.363	3	.	.801	3	.117
	Induction CJ	.299	3	.	.914	3	.430
	Non Induction CJ	.353	3	.	.824	3	.172

Note: CSF: Cherry Small Fry; CJ: Cherry Jepang

Based Test Levene homogeneity test all variables measured showed significant values > 0.05 (p> 0.05) so that all data can be concluded homogeneous (Table 2).

Table 2
Homogeneity Test Result Data with Levene Test

Variables	Levene Statistic	df1	df2	Sig.
Production	1.475	3	8	.293
Moisture content	1.909	3	8	.207
Vitamin C	1.527	3	8	.280
Carotene	1.909	3	8	.207

If the value of variables between groups p <0.05 then we can conclude there is a significant difference between treatments. Table 3 shows the measured variable has a value of p<0.05 so it can be concluded production, moisture content, vitamin C and carotene were significantly different between treatments.

Table 3
Anova Test Results

Variables	Analysis	Sum of Squares	df	Mean Square	F	Sig.
Production	Between Groups	365637.450	3	121879.150	4.994	.031
Moisture content	Between Groups	17.716	3	5.905	22.735	.000
Vitamin C	Between Groups	10967.367	3	3655.789	626.936	.000
Carotene	Between Groups	6.186E7	3	2.062E7	15.982	.001

a. Production

Table 4 shows the Small Fry Cherry tomato varieties (CSF) induction treatment with growth hormone significantly different with non-induced CSF tomato, but no different from tomato varieties Japanese Cherry (CJ) induced and non-induced. Tomato varieties CJ induced by growth hormone significantly different with tomato CSF non-induced and non-induced CJ, but not different with tomato CSF induction.

Table 4
Post Hoc Test Tomato Production Test by Treatment

	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Induction CSF	Non Induction CSF	361.00333*	127.55467	.022	66.8617	655.1449
		Induction CJ	-38.83000	127.55467	.769	-332.9716	255.3116
		Non Induction CJ	288.67000	127.55467	.053	-5.4716	582.8116
	Non Induction CSF	Induction CSF	-361.00333*	127.55467	.022	-655.1449	-66.8617
		Induction CJ	-399.83333*	127.55467	.014	-693.9749	-105.6917
		Non Induction CJ	-72.33333	127.55467	.586	-366.4749	221.8083
	Induction CJ	Induction CSF	38.83000	127.55467	.769	-255.3116	332.9716
		Non Induction CSF	399.83333*	127.55467	.014	105.6917	693.9749
		Non Induction CJ	327.50000*	127.55467	.033	33.3584	621.6416
	Non Induction CJ	Induction CSF	-288.67000	127.55467	.053	-582.8116	5.4716
		Non Induction CSF	72.33333	127.55467	.586	-221.8083	366.4749
		Induction CJ	-327.50000*	127.55467	.033	-621.6416	-33.3584

CSF: Cherry Small Fry; CJ: Cherry Jepang

Duncan's test showed that induced growth hormone CJ tomatoes had the highest production with an average number of 2449.10 grams (Table 5).

Table 5
Duncan Test Result of Tomato Production by Treatment

	Treatment	N	Subset for alpha = 0.05		
			1	2	3
Duncan[a]	Non Induction CSF	3	2049.2667		
	Non Induction CJ	3	2121.6000	2121.6000	
	Induction CSF	3		2410.2700	2410.2700
	Induction CJ	3			2449.1000
	Sig.		.586	.053	.769

b. Moisture content

Table 6 shows the significantly different growth hormone induced Cherry Small Fry (CSF) tomatoes with Japanese Cherry (CJ) induction and non-induced CJ, but no different from non-induced CSF tomatoes. Tomato CJ varieties induced by growth hormone differed significantly with induced CSF tomatoes and non-induced CSF, but no different from non-induced CJ tomatoes.

Table 6
Post Hoc Test Result of Tomato Moisture Content by Treatment

	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Induction CSF	Non Induction CSF	.07667	.41613	.858	-.8829	1.0363
		Induction CJ	2.07333*	.41613	.001	1.1137	3.0329
		Non Induction CJ	2.76333*	.41613	.000	1.8037	3.7229
	Non Induction CSF	Induction CSF	-.07667	.41613	.858	-1.0363	.8829
		Induction CJ	1.99667*	.41613	.001	1.0371	2.9563
		Non Induction CJ	2.68667*	.41613	.000	1.7271	3.6463
	Induction CJ	Induction CSF	-2.07333*	.41613	.001	-3.0329	-1.1137
		Non Induction CSF	-1.99667*	.41613	.001	-2.9563	-1.0371
		Non Induction CJ	.69000	.41613	.136	-.2696	1.6496
	Non Induction CJ	Induction CSF	-2.76333*	.41613	.000	-3.7229	-1.8037
		Non Induction SF	-2.68667*	.41613	.000	-3.6463	-1.7271
		Induction CJ	-.69000	.41613	.136	-1.6496	.2696

The Duncan test showed that non-induced growth hormone CJ tomatoes had the lowest moisture content of 89.84% (Table 7).

Table 7
Duncan Test Result of Tomato Moisture Content by Treatment

	Treatment	N	Subset for alpha = 0.05	
			1	2
Duncan [a]	Non-Induction CJ	3	89.8433	
	Induction CJ	3	90.5333	
	Non-Induction CSF	3		92.5300
	Induction CSF	3		92.6067
	Sig.		.136	.858

c. Vitamin C

Table 8 shows the significantly different growth hormone-induced Cherry Small Fry (CSF) tomatoes with non-induced CSF tomatoes, non-induced and induced Cherry Japanese (CJ) tomatoes. Tomato CJ varieties induced by growth hormone differ significantly with induced CSF tomatoes, non-induced CSF tomatoes, and non-induced CJ tomatoes.

Table 8
Post Hoc Test Result of Vitamin C Tomato by Treatment

	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Induction CSF	Non Induction CSF	5.10667*	1.97167	.032	.5600	9.6533
		Induction CJ	-70.48667*	1.97167	.000	-75.0333	-65.9400
		Non Induction CJ	-32.51333*	1.97167	.000	-37.0600	-27.9667
	Non Induction CSF	Induction CSF	-5.10667*	1.97167	.032	-9.6533	-.5600
		Induction CJ	-75.59333*	1.97167	.000	-80.1400	-71.0467
		Non Induction CJ	-37.62000*	1.97167	.000	-42.1667	-33.0733
	Induction CJ	Induction CSF	70.48667*	1.97167	.000	65.9400	75.0333
		Non Induction CSF	75.59333*	1.97167	.000	71.0467	80.1400
		Non Induction CJ	37.97333*	1.97167	.000	33.4267	42.5200
	Non Induction CJ	Induction CSF	32.51333*	1.97167	.000	27.9667	37.0600
		Non Induction CSF	37.62000*	1.97167	.000	33.0733	42.1667
		Induction CJ	-37.97333*	1.97167	.000	-42.5200	-33.4267

The Duncan test showed that induced growth hormone CJ tomatoes had the highest levels of vitamin C with an average of 133.07 mg / 100 g. (Table 9).

Table 9
Duncan Test Result of Vitamin C by Treatment

	Treatment	N	Subset for alpha = 0.05		
			1	2	3
Duncan [a]	Non-Induction CSF	3	57.4767		
	Induction CSF	3	62.5833		
	Non-Induction CJ	3		91.7633	

	Induction CJ	3			133.0700
	Sig.		.089	1.000	1.000

d. Carotene

Table 10 shows the significantly different growth hormone induced Cherry Small Fry (CSF) tomatoes with both induced and non-induced Cherry Japanese (CJ) tomatoes, but no different from non-induced CSF tomatoes. Tomato CJ varieties induced by growth hormone differ significantly with induced CSF induction and non-induced CSF tomatoes, but no different with non-induced CJ and tomatoes.

Table 10
Post Hoc Test Result of Carotene by Treatment

	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	Induction CSF	Non Induction CSF	-263.94000	927.40737	.783	-2402.5452	1874.6652
		Induction CJ	3275.75000*	927.40737	.008	1137.1448	5414.3552
		Non Induction CJ	5142.01000*	927.40737	.001	3003.4048	7280.6152
	Non Induction CSF	Induction CSF	263.94000	927.40737	.783	-1874.6652	2402.5452
		Induction CJ	3539.69000*	927.40737	.005	1401.0848	5678.2952
		Non Induction CJ	5405.95000*	927.40737	.000	3267.3448	7544.5552
	Induction CJ	Induction CSF	-3275.75000*	927.40737	.008	-5414.3552	-1137.1448
		Non Induction CSF	-3539.69000*	927.40737	.005	-5678.2952	-1401.0848
		Non Induction CJ	1866.26000	927.40737	.079	-272.3452	4004.8652
	Non Induction CJ	Induction CSF	-5142.01000*	927.40737	.001	-7280.6152	-3003.4048
		Non Induction CSF	-5405.95000*	927.40737	.000	-7544.5552	-3267.3448
		Induction CJ	-1866.26000	927.40737	.079	-4004.8652	272.3452

The Duncan test showed that non-induced growth hormone CSF tomatoes had the highest carotene content with an average number of 15297.09 ug / 100 g (Table 11).

Table 11
Duncan Test Result of Carotene by Treatment

	Treatment	N	Subset for alpha = 0.05	
			1	2
Duncan [a]	Non-Induction CJ	3	9891.1467	
	Induction CJ	3	11757.4067	
	Induction CSF	3		15033.1567
	Non-Induction CSF	3		15297.0967
	Sig.		.079	.783

Discussion

Duncan's test showed that growth-induced CJ-induced CJ tomatoes had the highest production with an average number of 2449.10 grams, followed by an induced tomato CSF with an average of 2410.27 grams (Table 5). Non-induced growth hormone CJ tomato has the moisture content with an average amount of 89.84%, followed by an induced CJ tomato with an average number of 90.53% (Table 7). The induced growth hormone CJ Tomato has the

highest vitamin C content with an average amount of 133.07 mg / 100 g, followed by non-induced CJ tomatoes with an average of 91.76% (Table 9). The non-induced growth hormone CSF tomato had the highest carotene content with an average amount of 15297.09 ug / 100 g, followed by CSF induced tomatoes with an average number of 15033.15 ug / 100 g (Table 11).

Based on the results obtained by treatment of growth hormone induction on CJ tomato is more suitable to obtain the product with high vitamin C content and lower water content. Carotene levels in CSF tomatoes indicate hormone induction has not been affected. The growth hormone formula used in this study contains auxin, gibberellin, and cytokinin also supplemented with vitamins such as thiamin, pyridoxine, nicotinic acid and several types of minerals. Hormones auxin effect on the process of parthenocarpy the formation of fruit without seed, stem growth and fruit growth. Gibberellin is one important factor that plays a role in spurring interest growth. Cytokines are growth regulators found in plants. Cytokines have a role in the process of cell division.

Several studies have revealed the role of hiohormons such as gibberellin, auxin, and cytokines or their combination of plant growth with a focus on flowering, growth, fertilization and storage. The study of the role of gibberellins against flowering by the treatment of dosing of 500 mg/l gibberellin in Spathiphyllum *muna loa* flower obtained flowering results at the tenth week after treatment, while the flowering control occurred only at twenty weeks (Abidin, 1985). Henny *et al.*, (2000) study of the role of gibberellin in Spathiphyllum varieties showed that higher concentrations of gibberellin produced higher amounts of interest (Henny *et al.*, 2000). Crane Research (1969) using 2,4,5-Trichlorofenoxy acetate as exogenous auxin applied to blackberries, grapes, strawberries, and oranges showed that fruit growth was 60 days faster than the normal phase average of 120 days (Crane, 1969). The Research of Parman (2015) on the given of gibberellin in IR-64 rice plants (Oryza Sativa var IR = 64) with concentrations varying from 5 mg / l to 20 mg / l. The result obtained is the concentration of gibberellin 10 mg / l is the optimum concentration of high growth and number of tillers of rice (Parman, 2015).

The research of Wulandari et al. stated giving gibberellin with a concentration of 200 ppm effect on fruit weight and a number of seeds on cucumber fruit mercy.[11)] Gibberellin synthesis that is usually available in the market is GA3, GA7, and GA13 (Wattimena *et al.*, 1991). The results showed that GA3 in peanut plants caused stunted to be high. Gibberellin is useful in the process of parthenocarpy (fruit without seeds) and the number of fruit bunches (Parnata, 2004).

The results of research on the immersion of Delaware type of grapes fruit at the time before flowering in an aqueous solution of GA3 can yield 88-96% seedless fruit. Gibberellin is useful in the engineering process to produce unbranded fruit and increase the number of bunches in fruit and increase fruit yield. Giving of gibberellins can also cause the harvested fruits to not quickly rot, making them more durable (Gardner *et al.*, 1991).

In the germination phase, the role of gibberellins is very advantageous. Gibberellin helps the enzymatic process to convert starch into sugars which are subsequently translocated into the embryo. Sugar will be used as a source of energy for growth, so growth is fast. Gibberellins can increase cambium activity and xylem development so growth activity can smoothly and quickly (Salisbury and Ross, 1995).

The research of Asra and Ubaidillah (2012) showed that gibberellin concentration in calopogonium caeruleum plant has no significant effect on crude protein, acid detergent and neutral detergent fiber in calopogonium caeruleum (Asra and Ubaidillah, 2012), however Asra (2014) stated that the interaction of GA3 concentration (500 ppm) and soaking time (24 hours) showed a significant effect on the percentage of germination and vigorous calopogonium caeruleum (Asra, 2014).

The use of gibberellin in grapefruit causes grapes resistant to fungal infections. Spraying gibberellin on citrus fruit and leaves can prevent the interference of the fruit skin and keep skin tight during storage. Therefore gibberellin can cause plants to be more resistant to disease (Salisbury and Ross, 1995; Abidin, 1985; Parnata, 2004).

Cytokines are often also called kinetin and are a generic name for growth substances that specifically stimulate cell division (Gardner *et al.*, 1991). The growth regulator auxin, gibberellins, and cytokinins work synergistically in plants that are characterized by plant growth. The growth regulator substances given to potato plants simultaneously show a rapid growth of buds in the development of potato plant stolon. At certain concentrations, the growth regulator can support or inhibit cell division, which a role in the growth and development of plants so that plants remain healthy (Danoesastro, 1976; Salisbury and Ross, 1995).

Based on the results of research supporting this research, among others, (Crane, 1969; Parman, 2015; Pranata, 2004; Gardner *et al.*, 1991) showed that the effect of gibberellin affects growth, which in turn has an impact on increased production. Asra and Ubaidillah (2012) obtained gibberellin results have not been able to increase the nutrient content, especially crude protein content, acid detergent fiber and neutral detergent fiber in calopogonium

caeruleum plant. These results do not support considering the results of research states gibberellin can increase the content of nutrients, especially vitamin C and carotene.

4. Conclusion

Induction of growth hormone in tomato plants can increase the amount of production, with high levels of vitamin C and low water content. The recommended tomato varieties to be developed are Japanese Cherry varieties (CJ) compared to Cherry Small Fry tomatoes (CSF).

Conflict of interest statement and funding sources

The author(s) declared that (s)he/they have no competing interest. The study was financed by the authors.

Statement of authorship

The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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