IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 8, Issue 2 Ver. II (Feb. 2015), PP 32-41
www.iosrjournals.org

Estimation of Genetic Parameter and Genotype Selection of F5 As A Result Of Crossbred on Tomato (Lycopersicum Esculentum Mill) In Organic Breeding

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Abstract: *Objective of this research was to obtain F6 genotype, which has high productivity by organic breeding. The research was conducted from June – October 2013 at Torongrejo village, Junrejo subdistrict, Batu, East Java at the altitude of ± 700 m above sea level. The research applied the Randomized Complete Design by three replications and 9 genotypes of F5 generation as treatment. Selection was done in organic breeding that specified in applying organic pesticide and fertilizer without any synthetic chemicals. Result of the research showed that the selection was done on characters, such as number of good fruits, weight of good fruit, number of total fruits, and weight of total fruits due to have the high coefficient values of genotypic and phenotypic variability, heritability and high expected genetic advance, as well as having significant and positive values for phenotypic and genotypic correlations with weight of total fruits. Based on result of the selection, 6 genotypes of organic tomato was obtained, which included LV.2.128.1.23.2, LV.2.128.6.18.42, LV.2.128.6.18.44, LV.2.128.7.3.45, LV.2.128.7.5.17, LV.2.128.7.10.27 that are potential to have high productivity. Variability in each genotype is still high, so that selection was done on individual that is potential to have high productivity in organic breeding.*
Keywords: *Genetic parameter, organic breeding, selection, tomato*

I. Introduction

Tomato (Lycopersicum esculentum Mill.) is vegetable commodity, which is mostly consumed by the people and it has been developed by the farmers as commercial farming operation. According to Tugiyono (1991), tomato contains some essential substances, which are good for human health, such as vitamin C, A (carotene), and mineral.

Today, tomato breeding is highly concerned, particularly in cultivation technique. Most of the tomato breeding technique use high inorganic materials, such as inorganic fertilizers, pesticides, herbicides, and other chemical products that are dangerous for human health due to the application of high dosages continuously. If the cultivation by inorganic principles were applied, it might be very harmful to human health due to the chemicals were still attached on the consumed tomatoes. Besides that, it has been proven that the use of chemical materials causes more pollution, which contributes to the degradation of the environmental functions and natural resources damage, as well as the decreasing environmental support capacity. However, the public starts to perceive the negative impact of the excessive chemicals use in farming purpose, so that most of them start to turn to farming that is oriented to environmentally safe by applying organic agriculture.

Breeding the organic tomato is basically similar to the conventional farming, but only the maintenance is different. Nurtika et al., (1997) stated that one of improvement efforts in tomato breeding system is the application of organic fertilizer or stable manure, which are multipurpose, such as to prevent any leaching as early as possible, maintain the soil moisture, and supply both macronutrients and micronutrients.

More efforts have been taken to increase production and improve the tomato quality, and one of them is plant breeding. Today, more superior varieties are easily found commercially, but they are not specified for organic breeding. Nowadays, the genotype selection has been done through conventional technology along with high chemical materials (fertilizer, pesticide), so that the superior varieties would show different responses and their productivities do not conform to the description, if they are bred in organic system. In order to obtain new variety, which is specifically for organic system breeding, the genotype selection must be done in organic environment as well.

The plant breeding, which is done to develop variety that responds to organic system farming, is started by hybridization in order to obtain population that has variability, and then continued to selection in order to obtain genotype that conforms to the desired characters. In plant breeding, estimation of the genetic parameter (heritability value and component of variance) of a population is really important to be done. Selection as the main activity in plant breeding will provide high genetic advance if the selected character has high heritability value, so that it will gain new variety that responds to organic farming system.

Selection on seven genotypes of tomato F3 as a result of crossbred between LV1684 x LV 4066, which comprised of LV.2.32.4; LV.2.32.11; LV.2.32.14; LV.2.128.1; LV.2.128.6; LV.2.128.7; and LV.2.144.3, have been bred in organic system in Magetan, East Java, from October 2011 – March 2012. Results of the research found 16 individuals of tomato F4 that derived from 4 genotypes as a result of crossbred between LV 2.32.14 (2 individuals), LV.2.128.1 (1 individual), LV.2.128.6 (6 individuals), and LV.2.128.7 (7 individuals) that have fresh weight of fruit 1500 – 2330 g/plant. Selection on genotypes of tomato F4 was conducted in Batu, East Java, from November 2012 – February 2013, and resulted 9 genotypes of tomato F5, which were bred in organic farming system by specifying in the application of organic pesticides and fertilizers. The genotypes were selected from this tomato F5 family will follow the next selection to obtain the genotype of tomato F6, which were bred in organic farming system by specifying in the application of organic pesticides and fertilizers, and it is expected that it would result superior variety. Objective of the research was to obtain genotype of F6 that has high productivity through organic breeding.

II. Material And Methods

The research was conducted at Torongrejo village, Junrejo subdistrict, Batu, East Java at the altitude of ± 700 m above sea level. The research was conducted from June – October 2013.

Equipments used for the research included seedling container, hand sprayer, pincers, rope, silvery black mulches, stake/marker (intact bamboo), label paper, measurement, scales, digital camera, farm tools, and writing utensils. Materials of the research were 9 genotypes of tomato F5 as a result of crossbred between LV 1684 x LV 4066, which included LV.2.32.14.7.5, LV.2.128.1.23.2, LV.2.128.1.23.22, LV.2.128.6.18.4, LV.2.128.6.18.42, LV.2.128.6.18.44, LV.2.128.7.3.45, LV.2.128.7.5.17 and LV.2.128.7.10.27. Materials of the research include goat's drops, liquid organic fertilizer, compost, soil, and sand.

The research applied the Randomized Complete Design (RCD) by three replications and 9 genotypes of F5 generation as treatment. Selection was done in organic breeding that specified in applying organic pesticide and fertilizer without any synthetic chemicals.

Observation was done on the whole individual plants. The observed characters in this research include qualitative and quantitative characters. Quantitative characters include : plant height, days of flowering, number of flowers, number of flower recemus, number of fruits per recemus, fruit set, days of early harvest, days of late harvest, number of good fruits per plant, number of bad fruits per plant, number of total fruits per plant, weight of good fruits per plant, weight of bad fruits per plant, weight of total fruits per plant, and weight per fruit. Qualitative characters include : growth type, leaf type, fruit tip mark, color of ripe fruits, and the fruit shape.
Data of analysis used in this research comprises of five analysis, such as :

2.1 Analysis of Variance

If any difference exists, it will be continued to Least Significant Difference (LSD) of 5% in order to find out the difference between treatments. Analysis of variance is presented in Table 1 below :

Table 1. Analysis of Variance

Variability Source	db	JK	KT
Replication (r)	r-1	JKr	KTr (M3)
Genotype (g)	g-1	JKg	KTg (M2)
Pooled error (e)	(r-1)(g-1)	Jke	Kte (M1)
Total	rg-1	JKt	

Estimation of the genetic variance component as well as the phenotypic variance based on Table 1, according to Singh and Chaudhary (1985):

$\sigma^2 e = M1 = KTe$

$\sigma^2 g = (M2 – M1) / r = (KTg – Kte) / r$

$\sigma^2 p = \sigma^2 g + \sigma^2 e$

2.2 Coefficient of Genotypic and Phenotypic Variability

Coefficient of Genotypic Variability (CGV) is counted in accordance with Singh and Chaudhary (1985) by the equation below :

$$KKG = \frac{\sqrt{\sigma_g^2}}{\overline{X}} \times 100\ \%$$

Based on criteria by Miligan et al. (1996), coefficient of genetic variability is divided into three categories, such as: low = < 5%, medium = 5 – 14.5%, high = >14.5%

Coefficient of Phenotypic Variability (CPV) is counted in accordance with Singh and Chaudhary (1985) by the equation below :

$$\text{KKF} = \frac{\sqrt{\sigma_p^2}}{\overline{X}} \text{ x } 100\ \%$$

Based on Knight (1979), CPV (KKF) value is categorized into: low = 0 – 10%, medium = 10 – 20%, high = > 20%.

2.3Estimation of Heritability Value

In wide sense, heritability is counted using the equation by Basuki (1997) as follows :

$$h^2 = \frac{\sigma_g^2}{\sigma_g^2 + \sigma_e^2}$$

Criteria for estimated value of heritability according to Whirter (1979) are as follow : high if the value is $h^2 > 0.5$, medium if the value is $0.2 \leq h^2 \leq 0.5$, and low if the value is $h^2 < 0.2$.

2.4Estimation of the Selection Response Value

Selection response value or genetic advance is counted using the equation by Knight (1979) as follows :

$$KG = i \text{ x } h^2 \text{ x } \sigma_p$$

Based on the equation, the genetic advance value is the product of selection intensity 10% = 1.76 (i), heritability value (h^2), and phenotypic standard deviation (σ_p).

According to Knight (1979), the Expected Genetic Advance (EGA) can be counted using the equation :

$$KGH = \frac{KG}{\overline{X}} \ x\ 100\%$$

Criteria of the genetic advance are < 0-7 = low; 7,1–14 % = medium; > 14,1 % = high.

2.5 Correlation

Coefficients for genotypic and phenotypic correlation of the trait pairs, are counted an accordance with formula by Singh and Chaudhary (1985) as follow :

1) Coefficient of phenotypic correlation is counted using the equation below :

$$r_{P(xy)} = \frac{Cov_{P(xy)}}{\sqrt{(\sigma_{px}^2)(\sigma_{py}^2)}}$$

2) Coefficient of genotypic correlation is counted using the equation below :

$$r_{G.(xy)} = \frac{Cov_{G(xy)}}{\sqrt{(\sigma_{Gx}^2)(\sigma_{Gy}^2)}}$$

2.6 Population Variability in Genotype

The phenotypic variance is counted in accordance with result of the observation on each population F_5 in each genotype using the equation by Hanafiah (1994), as follows :

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(X_i - \mu)^2$$

In which σ^2 is variance, Xi is value of the quantitative character that being observed, μ mean of each quantitative character that being observed, and N is number of plants.

The environmental variance (σ^2e) is counted in accordance with result of pooled error median quadrate (KTe) on analysis of variance. The genotypic variance (σ^2g) is counted by the equation below :

$$\sigma^2 g = \sigma^2 p - \sigma^2 e$$

Coefficient of phenotypic variability (CPV) and coefficient of genotypic variability (CGV) in each genotype is counted in accordance with Singh and Chaudhary (1985).

III. Result

3.1 Condition of Planting

Planting in the field was started from June to October 2013 at the altitude of 700 meter above sea level. Unpredictable weather at the beginning of the research highly affected the planting condition, in general. The weather was bright in the morning and in the afternoon, but the rain frequently fell late in the afternoon and at night. High rainfalls along with heat, which lasted continuously, highly affected the growth and development of tomato in the field. Such condition caused high infection of pest and diseases on tomato. High rainfalls had disturbed the flowering process and the fruit development.

Diseases that infect tomato during the vegetative phase include stem collapse and fusarium wilt that cause death to several plants. Refilling is done on the dead plant before 10 days after planting, so that the growth will be parallel and facilitate in maintenance. Besides that, physiological disorders are found in tomato, such as fruit tip rot, split fruit, and sun-burned.

3.2 Result of the observation on quantitative character

Result for the analysis of variance on 15 parameter of observation on quantitative characters, it found seven parameter of observation that had insignificant differences and eight parameter of observation that had significant differences. Seven parameter that had insignificant difference included plant height, number of flowers, days of flowering, early harvest, late harvest, number of bad fruits, and weight of bad fruits. Mean of eight parameter that have significant difference are presented in Table 2 below.

Table 2. Mean of eight parameter of observation on quantitative characters of 9 genotypes in organic tomato

Genotype	JT		JB		FS		BB		JBB		JBT/Tan		BBB		BBT	
(G_1)	8.43	ab	3.75	b	32.54	a	39.94	c	11.05	a	16.55	a	399.83	a	578.23	abc
(G_2)	10.43	abc	4.12	b	49.88	c	29.73	b	25.77	bcd	30.98	bc	759.35	c	908.65	d
(G_3)	8.17	a	3.08	a	34.61	ab	17.82	a	19.50	abc	23.77	ab	454.70	ab	551.19	ab
(G_4)	8.05	a	3.70	ab	41.64	ab	19.84	a	19.07	ab	22.87	ab	390.35	a	460.64	a
(G_5)	10.012	abc	3.83	b	41.67	ab	29.26	b	24.27	bcd	28.52	bc	762.58	c	881.60	d
(G_6)	9.40	abc	3.75	b	43.35	b	25.61	ab	24.20	bcd	29.08	bc	678.75	bc	815.52	bcd
(G_7)	11.43	c	4.18	b	46.83	c	24.38	ab	30.27	d	34.25	c	744.40	c	838.12	cd
(G_8)	10.82	bc	4.23	b	48.66	c	25.78	ab	27.95	cd	33.52	c	714.05	c	858.23	cd
(G_9)	11.80	c	4.33	b	48.56	c	26.49	ab	31.20	d	36.18	c	814.98	c	946.34	d
LSD 5%	**2.51**		**0.66**		**10.63**		**8.86**		**8.54**		**9.63**		**252.98**		**281.93**	

Note : numbers in the same column, which are followed by the same letters do not show any significant difference on LSD test of 5%, G_1 (LV.2.32.14.7.5), G_2 (LV.2.128.1.23.2), G_3 (LV.2.128.1.23.22), G_4 (LV.2.128.6.18.4), G_5 (LV.2.128.6.18.42), G_6 (LV.2.128.6.18.44), G_7 (LV.2.128.7.3.45), G_8 (LV.2.128.7.5.17), G_9 (LV.2.128.7.10.27), **JT=** number of recemes, **JB=** number of fruits per recemus, **FS=** Fruit Set, **BB**=weight per fruit, **JBB**= number of good fruits, **JBT/Tan**=number of total fruits per plant, **BBB**= weight of good fruits, **BBT/Tan**=weight of total fruits per plant.

Data analysis on characters for number of recemes per plant, genotypes of G_3 and G_4 have low value and have insignificant difference with other genotype, except G_7, G_8 and G_9, while on genotypes of G_7 and G_9 have high and insignificant difference with other genotypes, except with genotypes of G_3 and G_4. Observation on number of fruits per recemus, genotype G_3 has low value and significant difference with other genotype, except with genotype of G_4. Observation on fruit set among the tested genotypes shows significant difference. Genotype G_1 has low value and has significant difference with genotypes G_2, G_6, G_7, G_8 and G_9, but has insignificant difference with genotypes G_3, G_4 and G_5. Genotypes G_2, G_7, G_8 and G_9 have high values and significant differences with other genotypes. Result of the observation on weight per fruit shows that the tested genotypes have significant differences. Genotype G_3 and G_4 have low weight and insignificant differences with other genotypes, except with genotypes G_1, G_2 and G_5, while genotype G_1 has the highest weight and significant difference with other genotypes. Result of data analysis on number of good fruits shows that the tested genotypes have significant differences. Genotype G_1 has low value and significant difference with other genotypes, except with genotypes G_3 and G_4. Genotypes G_7 and G_9 have high values and significant differences with genotypes G_1, G_3 and G_8, but have insignificant differences with genotypes G_2, G_5, G_6 and G_8. For number of total fruits, genotype G_1 has low value and significant difference with other genotypes, but has insignificant difference with genotypes G_3 and G_4. Genotypes G_7, G_8 and G_9 have high values and significant differences with genotypes G_1, G_3 and G_4, but they have insignificant differences with genotypes G_2, G_5 and G_6. Result of data analysis on weight of good fruits shows that the tested genotypes have significant differences. Genotypes G_1 and G_4 have low values and significant differences with other genotypes, except with the genotype G_3. Genotypes G_2, G_5, G_7, G_8 and G_9 have high values and significant differences with genotypes G_1, G_3 and G_4, but have insignificant differences with genotype G_6. For weight of total fruits, genotype G_4 has low value and significant difference with other genotypes, except with genotypes G_1 and G_3. Genotypes G_2, G_5 and G_9 have high values and significant differences with genotypes G_1, G_3 and G_4, but have insignificant differences with genotypes G_6, G_7 and G_8. Data of the observation results on eight parameter of quantitative characters for 9 genotypes of organic tomato is presented completely in Table 2.

3.3 Genetic Variability

Result of calculation for genotypic variability coefficient on character of growth and yield component, as well as the yield showed that characters for plant height, days of flowering, number of recemus, number of fruit/recemus, fruit set, and days of late harvest have medium values for the coefficient of genotypic and phenotypic variability. For number of flower character, it has medium value for coefficient of genotypic variability and high value for coefficient of phenotypic variability. For days of early harvest, it has low value for the coefficient of genotypic variability and medium value for coefficient of the phenotypic variability. For number of bad fruits, it has low value for coefficient of the genotypic variability, but high value for coefficient of the phenotypic variability. High values for coefficient of genotypic and phenotypic variability belong to number of good fruits, weight of good fruits, weight of bad fruits, weight of total fruits, and weight per fruit. Result of the observation on coefficient of phenotypic and genotypic variability of various characters of growth and yield component, as well as the yield, which are presented completely in Table 3 below.

Table 3. Coefficient of phenotypic and genotypic variability of various characters of growth, yield component, and yield on 9 genotypes of organic tomato.

No.	Parameter of Observation	$\sigma^2 g$	$\sigma^2 p$	KKG		KKF	
				(%)	Criteria	(%)	Criteria
1	Plant height	24.80	150.67	5.83	medium	14.37	medium
2	Days of flowering	3.94	14.47	6.65	medium	12.75	medium
3	Number of flowers	49.74	156.31	11.60	medium	20.56	high
4	Number of recemus	1.29	3.39	11.53	medium	18.70	medium
5	Number of fruits/recemus	0.10	0.25	8.07	medium	12.76	medium
6	Fruit set	25.97	63.73	11.83	medium	18.53	medium
7	Days of early harvest	4.47	58.85	3.10	low	11.26	medium
8	Days of late harvest	31.44	107.11	6.83	medium	12.60	medium
9	Number of good fruits	32.07	56.40	23.90	high	31.69	high
10	Number of bad fruits	0.00	1.59	0.00	low	26.69	high
11	Number of total fruits	29.76	60.72	19.20	high	27.43	high
12	Weight of good fruits	21,871.61	43,230.59	23.27	high	32.72	high
13	Weight of bad fruits	533.73	1,814.74	18.39	high	33.90	high
14	Weight of total fruits	23,245.31	49,772.69	20.07	high	29.36	high
15	Weight per fruit	31.75	57.99	21.23	high	28.69	high

3.4 Heritability and expected genetic advance

Result of the heritability calculation on characters of growth, yield component, and yield showed that plant height, days of early harvest, and number of bad fruits have low values, and result of calculation for the expected genetic advance on those three parameter have low values as well. Meanwhile, days of flowering and days of late harvest have medium heritability values, but the expected genetic advance has low value. Moreover, number of flowers, number of recemus, and number of flowers per recemus, as well as fruit set have medium values for heritability and the expected genetic advance. Number and weight of total fruits, as well as weight of bad fruits have medium heritability values, but the expected genetic advance has high value. Number and weight of good fruits, as well as weight per fruit have high values for heritability and the expected genetic advance. Results of calculation for heritability and the expected genetic advance on various characters of growth and yield component, as well as the yield are presented completely in Table 4 below.

Table 4. Heritability and the expected genetic advance on various characters of growth, yield component, and yield in 9 genotypes of organic tomato

No.	Parameter of Observation	h^2		Response of Selection	KGH	
		Value	Criteria		(%)	Criteria
1	Plant height	0.17	Low	3.56	4.16	Low
2	Days of flowering	0.27	Medium	1.83	6.11	Low
3	Number of flowers	0.32	Medium	7.00	11.51	Medium
4	Number of recemus	0.38	Medium	1.23	12.51	Medium
5	Number of fruits/recemus	0.40	Medium	0.35	8.99	Medium
6	Fruit set	0.41	Medium	5.73	13.29	Medium
7	Days of early harvest	0.08	Low	1.03	1.51	Low
8	Days of late harvest	0.29	Medium	5.35	6.51	Low
9	Number of good fruits	0.57	High	7.52	31.71	High
10	Number of bad fruits	0.00	Low	0.00	0.00	Low
11	Number of total fruits	0.49	Medium	6.72	23.66	High
12	Weight of good fruits	0.51	High	185.14	29.14	High
13	Weight of bad fruits	0.30	Medium	22.05	17.55	High
14	Weight of total fruits	0.47	Medium	183.38	24.13	High
15	Weight per fruit	0.55	High	7.34	27.65	High

3.5 Genotypic and Phenotypic Correlation

Correlation among characters, such as plant height, days of flowering, number of flowers, number of recemus, number of fruits/recemus, fruit set, days of early harvest, days of late harvest, number of good fruits, number of bad fruits, number of total fruits, and weight of good fruits, weight of bad fruits, weight of total fruits, and weight per fruit, which are stated by coefficient of genotypic and phenotypic correlations. Genotypically, it shows significant and positive correlation between weight of total fruits and number of flowers, number of recemus, number of fruits per recemus, fruit set, days of late harvest, number of good fruits, number of total fruits, and weight of good fruits. Besides that, some insignificant correlations are found between weight of total fruits and plant height, plant height, days of flowering, days of early harvest, weight of bad fruits, and weight per fruit.

Phenotypically, it shows significant and positive correlation between weight of total fruits and number of flowers, number of recemus, number of good fruits, number of total fruits, and weight of good fruits. Besides that, some insignificant correlations are found between weight of total fruits and plant height, days of flowering, number of fruits per recemus, fruit set, days of early harvest, days of late harvest, number of bad fruits, weight of bad fruits, and weight per fruit.

3.6 Variability of population in genotype

Result of calculation on variability of population in genotype was obtained by calculating coefficient of phenotypic and genotypic variability on characters of the observation. Data as presented in Table 5 shows that on genotype LV.2.128.1.23.2 (G_2) in the quantitative character has low to high criteria. High coefficient of phenotypic variability is found on the entire characters of observation except for days of early and late harvest that have low values and medium values for plant height and number of fruits per recemus. The highest value for coefficient of phenotypic variability is found on weight of bad fruits for about 89.14 %, while the lowest value is found on days of late harvest for about 6.20 %. The genotypes LV.2.128.6.18.42 (G_5) and LV.2.128.6.18.44 (G_6) have high values coefficient of the genotypic and phenotypic variability on all characters of the quantitative observation. Result of calculation for coefficient of phenotypic and genotypic variability on genotypes LV.2.128.1.23.2, LV.2.128.6.18.42 and LV.2.128.6.18.44 are presented in Table 5.

Table 5. Variability of Population on Genotypes LV.2.32.14.7.5, LV.2.128.1.23.2 and LV.2.128.1.23.22.

Character	LV.2.128.1.23.2 (G_2)				LV.2.128.6.18.42 (G_5)				LV.2.128.6.18.44 (G_6)			
	KKF		KKG		KKF		KKG		KKF		KKG	
	(%)	Criteria	(%)	Criteria	(%)	Criteria	(%)	Criteria	(%)	Criteria	(%)	Criteria
TT	10.67	medium	-	-	31.81	high	28.64	high	38.08	high	35.34	high
UB	31.63	high	18.59	high	83.31	high	25.26	high	88.09	high	28.17	high
JBG/Tan	34.91	high	31.14	high	41.86	high	38.49	high	54.53	high	51.65	high
JT	34.67	high	31.94	high	41.91	high	39.32	high	54.60	high	52.38	high
JB	16.65	medium	13.73	medium	35.10	high	33.64	high	40.00	high	38.64	high
FS (%)	27.93	high	24.59	high	44.23	high	41.70	high	39.30	high	36.66	high
UAwP	6.75	low	-	-	30.72	high	28.60	high	33.64	high	31.71	high
UAkP	6.20	low	-	-	30.88	high	28.81	high	33.93	high	32.10	high
JBB	46.85	high	42.76	high	54.64	high	50.72	high	60.83	high	57.32	high
JBJ	68.14	high	63.31	high	87.37	high	81.75	high	87.29	high	83.11	high
JBT/Tan	46.30	high	42.68	high	52.48	high	48.71	high	60.98	high	57.91	high
BBB	47.56	high	43.50	high	57.83	high	54.56	high	63.76	high	60.01	high
BBJ	89.14	high	85.86	high	108.93	high	104.69	high	96.95	high	93.35	high
BBT/Tan	51.15	high	47.91	high	58.50	high	55.51	high	66.20	high	63.12	high
BB	24.48	high	17.39	high	40.57	high	36.61	high	49.57	high	45.36	high

Notes : **TT=** plant height, **JBG/Tan**= number of flowers per plant,**JT**= number of recemus, **JB**= number of fruits per recemus, **FS**= Fruit Set, **UB=** days of flowering, **UAwP**= days of early harvest, **UakP**= days of late harvest, **JBB**= number of good fruits, **JBJ**= number of bad fruits, **JBT/Tan**= number of total fruits per plant, **BBB**= weight of good fruits, **BBJ**= weight of bad fruits, **BBT/Tan**= weight of total fruits per plant, **BB**= weight per fruit

Table 6 shows that the genotype LV.2.128.7.3.45 (G_7) has high value for coefficient of phenotypic variability on all characters of quantitative observation, except for plant height, days of early and late harvests that have medium values. As well as coefficients of genotypic variability that have high values for all characters of quantitative observation, except for plant height, days of early and late harvests that have medium values. On genotype LV.2.128.7.5.17 (G_8), it has high value for coefficient of phenotypic variability on all characters of quantitative observation, except for plant height, days of early and late harvests that have low values. The highest value for coefficient of variability belongs to weight of bad fruits, 91.78 %, and the lowest belongs to days of late harvest, 3.86 %. Coefficient of the genotypic variability on genotype LV.2.128.7.5.17 (G_8) has high value for all characters of the quantitative observation, except for number of fruits and fruit set that have medium value and plant height, days of early and late harvest that have no KKG value due to the genotype variance is negative. On genotype LV.2.128.7.10.27 (G_9), has high value for coefficient of phenotypic variability on all characters of quantitative observation, except for plant height and number of fruits per recemus that has medium value, while days of early and late harvest have low value. The highest value for coefficient of variability is on weight of bad fruits for about 88.66 % and the lowest is on days of late harvest for about 5.74 %. The genotype of LV.2.128.7.10.27 (G_9) has high value for coefficient of genotypic variability on all characters of quantitative observation, except for plant height that has low value and fruit set that has medium value, as well as days of flowering, days of early and late harvests that have no KKG values due to the genotypic variance has negative value. Result of the calculation for coefficient of the phenotypic and genotypic variability on genotype LV.2.128.7.3.45 (G_7), LV.2.128.7.5.17 (G_8) and LV.2.128.7.10.27 (G_9) are presented in Table 5.

Table 6. Variability of Population on Genotype LV.2.128.7.3.45, LV.2.128.7.5.17 and LV.2.128.7.10.27.

Character	LV.2.128.7.3.45 (G_7)				LV.2.128.7.5.17 (G_8)				LV.2.128.7.10.27 (G_9)			
	KKF		KKG		KKF		KKG		KKF		KKG	
	(%)	Criteria	(%)	Criteria	(%)	Criteria	(%)	Criteria	(%)	Criteria	(%)	Criteria
TT	17.68	medium	10.68	medium	9,56	low	-	-	12.03	medium	3.05	low
UB	43.68	high	24.40	high	25.38	high	8.01	medium	25.30	high	-	-
JBG/Tan	42.13	high	39.51	high	27.33	high	22.78	high	30.37	high	26.89	high
JT	41.10	high	39.11	high	27.35	high	23.83	high	30.63	high	28.06	high
JB	22.93	high	20.99	high	15.13	high	12.05	medium	17.27	medium	14.79	high
FS (%)	24.82	high	21.06	high	16.51	high	10.64	medium	18.29	high	13.21	medium
UAwP	15.03	medium	10.90	medium	6.49	low	-	-	7.36	low	-	-
UAkP	13.94	medium	9.89	medium	3.86	low	-	-	5.74	low	-	-
JBB	52.76	high	50.18	high	35.15	high	30.40	high	41.25	high	38.10	high
JBJ	76.90	high	69.54	high	65.71	high	61.30	high	68.88	high	63.69	high
JBT/Tan	49.24	high	46.48	high	34.31	high	30.02	high	39.84	high	36.75	high
BBB	57.09	high	53.61	high	42.38	high	37.10	high	45.93	high	42.28	high
BBJ	113.15	high	106.51	high	91.78	high	88.36	high	88.66	high	84.37	high
BBT/Tan	55.67	high	52.17	high	45.49	high	41.34	high	47.33	high	44.09	high
BB	29.69	high	20.98	high	28.91	high	21.01	high	30.31	high	23.34	high

Notes : **TT=** plant height, **JBG/Tan**= number of flowers per plant,**JT**= number of recemus, **JB**= number of fruits per recemus, **FS**= Fruit Set, **UB=** days of flowering, **UAwP**= days of early harvest, **UakP**= days of late harvest, **JBB**= number of good fruits, **JBJ**= number of bad fruits, **JBT/Tan**= number of total fruits per plant, **BBB**= weight of good fruits, **BBJ**= weight of bad fruits, **BBT/Tan**= weight of total fruits per plant, **BB**= weight per fruit

3.7 Result of observation on qualitative character

Result of observation on qualitative characters toward the growth type, leaf type, fruit tip mark, color of the ripw fruits and the fruit shape showed that variability has still found in both intra-and-inter-genotype. Out of five of the observed qualitative characters, leaf type and color of the ripe fruit showed variability, both inter-genotype and intra-genotype. Leaf type on 9 genotypes of the organic tomato show type 1 and color of the ripe fruit is orange. Result of observation on qualitative character showed that the growth type of each genotype is determinate and semi determinate.

On character of the fruit tip mark, it shows that genotypes G_3, G_5 and G_6 are homogeneous in the form of point, while other genotypes are still varied in the form of star and point. The fruit shapes of all genotypes are still varied. Results of observation on qualitative character are presented completely in Table 7 below.

Table 7. Qualitative character of the growth type, leaf type, fruit tip mark, color of the ripe fruit, and fruit shape on 9 genotypes of organic tomato.

Genotype	Type of Growth	Type of Leaf	Mark of Fruit Tip	Color of Ripe Fruit	Fruit Shape
1	determinate and semi determinate	type 1	point and star	orange	rather flat, round, square
2	determinate and semi determinate	type 1	point and star	orange	round, square, oval, egg-shaped
3	determinate and semi determinate	type 1	point	orange	square, oval, egg-shaped
4	determinate and semi determinate	type 1	point and star	orange	round, square, oval, egg-shaped
5	determinate and semi determinate	type 1	point	orange	square, oval, egg-shaped
6	determinate and semi determinate	type 1	point	orange	square, oval, egg-shaped
7	determinate and semi determinate	type 1	point and star	orange	round, square, oval, egg-shaped
8	determinate and semi determinate	type 1	star and point	orange	round, square, oval, egg-shaped
9	determinate and semi determinate	type 1	star and point	orange	round, square, oval

IV. Discussion

In general, tomato breeding is intended to increase productivity and quality of fruits that comprise of fruit size, fruit color, fruit shape, hardness of mesocarpium and tastes, improvement of resistant to certain pest and disease, as well as increasing traits to overcome specific environmental stress (Purwati, 1997). Based on objective of the tomato breeding, it requires selection on 9 genotypes of tomato F5 in organic breeding.

Variability of a population is caused by two factors, both genetic and environmental factors. Wide variability of a character will provide good opportunity in selection process due to the character improvement process has conformed as expected. According to Helyanto et al. (2000), if a character has high enough genetic variability, each individual in the population will be high as well, so that the selection will be easier to obtain the desired traits. Therefore, information about the genetic variability is highly required to obtain new variety as expected.

Table 3 presents the analysis result of the genotypic and phenotypic variability coefficient of each character on diverse character of observation on nine genotypes of organic tomato. High phenotypic variability is shown by number of flowers, number of good fruits, number of bad fruits, number of total fruits, weight of good fruits, weight of bad fruits, weight of total fruits, and weight per fruit. Different values were obtained from calculation on the coefficient values of phenotypic variability in each quantitative character of those nine genotypes in organic tomato. The coefficient values of the phenotypic variability belong to medium and high categories. Crowder (1997) stated that coefficient of variability is a method to compare variability of two disseminations (traits) that have standard deviation in different unit. Coefficient of variability measures the variability degree of the different data, so that it would be used to compare the variability degrees of each character in tomato's families, which are used in the research.

The analysis result for the coefficient of genotypic variability on each character shows that number of good fruits, number of total fruits, weight of good fruits, weight of bad fruits, weight of total fruits, and weight per fruit have high coefficient values for the genotypic variability (Table 3). According to Samudin and Saleh (2009), coefficient of the genetic variability is a measurement to determine whether the observed material has great genetic variance or not. It relates to selection activity on the observed population, therefore, the breeders have an interest in this value. Number of bad fruits has the lowest value (0%) for coefficient of the genotypic variability and number of good fruits has the highest value (23.90%) for coefficient of genotypic variability. High coefficient of genetic variability shows that genetic manipulation on a trait that has such coefficient, would has greater opportunity to be achieved, while traits that have low coefficient of genetic variability, would has less opportunity of success if the trait is being improved (Ronald, et. al., 1999).

The expected value of heritability on a character should be known to determine whether the character variability is mostly affected by genetical factor or environmental factor. Falconer and Mackay (1996) stated that a character that has high expected value of heritability indicates that appearance of the character is less affected by the environment. The selection would be effective on character that has high expected value of heritability due to less environmental effect. Table 12 shows that number of good fruits, weight of good fruits and weight per fruit have high heritability, while the characters of observation that have medium heritability values include days of flowering, number of flowers, number of recemus, number of fruits per recemus, fruit set, days of late harvest, number of total fruits, weight of bad fruits and weight of total fruits. Whirter (1979) stated that characters that belong to medium and high category of heritability mean that the environment plays less important in appearance of a character.

The genetic advance is one of indicators on the success of plant breeding. The genetic advance, which was obtained in a selection cycle, is expressed in accordance with value of the measurement unit. The expected genetic advance is the value of genetic advance in comparison with mean values, and it is usually used as measurement of advance. The genetic advance can be used as direction in determining the selection activity. If the expected genetic advance of a character is high, it means that there is greater opportunity to improve the character through selection. On the contrary, if the expected genetic advance of a character is low, the selection on the related character can be done in once generation to form uniform population or selection activity can be stopped due to the achieved improvement is relatively low. Based on Table 4, it shows that number of good fruits, number of total fruits, weight of good fruits, weight of bad fruits, weight of total fruits, and weight per fruit have high expected genetic advance. It means that the related characters could be selected in the next generation, so that the selection result would be effective.

Selection would be effective if the expected traits have extensive genetic variability, heritability, and high expected genetic advance. It conforms to statements by Handayani and Hidayat (2012) that selection is a process in plant breeding program, which is intended to improve characters and to obtain new variety. The selection activity is highly determined by the availability of wide genetic variability and high heritability. According to Poehlman (1991), some genetic parameters, which could be used as consideration in order to gain effective and efficient selection, include genetic variability, heritability, correlation, and effect of characters that relate to the result.

Effective selection could be done on characters of weight of good fruits, weight per fruit, and weight of total fruits due to have high values for coefficient of phenotypic and genotypic variability, heritability, and expected genetic advance. Besides that it has positive and significant values for coefficient of phenotypic and genotypic correlations toward weight of total fruits per plant. Based on mean for weight of good fruits, weight per fruit, and weight of fruit, G_2, G_5, G_6, G_7, G_8 and G_9 can be used as selected genotype for planting in the next generatio, so that out of 9 genotypes of organic tomato F5, it brings about 6 genotypes of organic tomato F6 that have high productivity and they can be planted in the next generation. Those six genotypes of organic tomato F6 include LV.2.128.1.23.2, LV.2.128.6.18.42, LV.2.128.6.18.44, LV.2.128.7.3.45, LV.2.128.7.5.17, LV.2.128.7.10.27.

Result of the research showed high phenotypic and genotypic variability in character of the yield component on 9 genotypes of organic tomato F5. It did not conform to opinion by Nasir (2001) that it is expected for most families of F5 and F6 have been homozygote in more locus, therefore selection among families can be done. The same opinion was suggested by Mangoendidjojo (2003) that homozygote proportion in generation F5 has reached 90%. In fact, high variability has still been found on the yield components, both phenotypic and genotypic variability, so that selection should be done on individual in these 6 selected genotypes F6 that have potential high productivity in organic breeding. It occurs due to the tomato’s flowers have self pollination (autogamy) and it is a monoecious type. However, cross pollination (allogamy) may occur as well. According to Delaplane and Mayer (2000), opportunity of allogamy on tomato in natural condition is about 0.07% to 12% and, in general, it occurs on variety that has long stylus and open stigma. Allogamy due to natural factors is caused by insects or wind. Selection on tomato of generation F5 in organic breeding is based on the pedigree method because the selection has been done on genotypes, which have segregation as the expected plant, since the population F2. Selection is done on individual that has potential yield more than 1.5 kilogram. Based on those 6 selected genotypes, 80 individuals were obtained, in which 17 individuals belong to G_2 (LV.2.128.1.23.2), 13 individuals belong to G_5 (LV.2.128.6.18.42), 13 individuals belong to G_6 (LV.2.128.6.18.44), 10 individuals belong to G_7 (LV.2.128.7.3.45), 12 individuals belong to G_8 (LV.2.128.7.5.17) and 15 individuals belong to G_9 (LV.2.128.7.10.27). Besides that, in the individual selection of the selected genotypes, the selection is also based on qualitative characters, such as the fruit shape. Most of the consumers prefer the oval shape to other shapes. Ameriana (1997) stated that consumers prefer the oval shape and hard mesocarpium to the other ones, so that such characteristics will facilitate the marketing of tomato.

V. Conclusion

1. Based on the selection process, it has found 6 genotypes of organic tomato, such as LV.2.128.1.23.2, LV.2.128.6.18.42, LV.2.128.6.18.44, LV.2.128.7.3.45, LV.2.128.7.5.17, LV.2.128.7.10.27, which are potentially to have high productivity.
2. Variability in each genotype is still high, so that selection was done on individual that has high potential productivity on organic breeding.
3. Selection was done on characters that include number of good fruits, weight of good fruits, number of total fruits, and weight of total fruits due to have high values for coefficient of genotypic and phenotypic variability, heritability, and the expected genetic advance, as well as have significant, positive genotypic and phenotypic correlation with weight of total fruits.

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