Character Performance of Ten Local Bengkulu Tomato Accessions

Dotti Suryati, Sylvia Molesta, and Eko Suprijono
Faculty of Agriculture, University of Bengkulu, Indonesia
dottisuryati@yahoo.com

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ABSTRACT

Tomato production in Indonesia is low and fluctuatif. In 2011, tomato production in Bengkulu province was 33.744 ton, and only 33.351 ton in 2012. Low production may be due to unsuitable varieties and inefficient technology practiced by farmers. Most of superior varieties are adapted to highland area. The use of high yielding varieties but only adapted to highland has neglected local adapted varieties that might importance for future varieties improvement for wider adaptation. Character variability occurring in local varieties is important to plant breeders as they might be useful for improving varieties. We studied 10 local accessions of tomato found in Bengkulu for characterizing and grouping them that can be used for future tomato breeding. The 10 accessions namely K-1,K- 2,C-1, C-2, RL-1,RL-2, RL-3,SB, S, and NB were grown in poly bags in October 2013 – January 2014, replicated four times. Observations were done weekly to record qualitative and quantitative characters such as colors of hypocotyl, leaves color, young fruits color, and ripened fruits color, growth type, plant height, flowering and harvesting ages, fruit size (diameter, horizontal cross-section of fruit), fruit hardness, fruit numbers per bunch, number of fruit bunches per plant, fruit numbers per plant, fruit weight of each, and fruit weight per plant. Based on the afore mentioned characters we found six accessions: K-1, K-2, C1, RL 1, RL-2, and NB might be valued for future breeding program on tomato.

Key words: tomato, accession, qualitative, quantitative.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.*)* is one of the most important Solanaceous vegetable crops. It is anhorticultural commodities that has important source of minerals andvitamins (Vitamin A and C), but the production in Indonesia is low and fluctuative. In 2011, tomato production in Bengkulu province was 33.744 ton, and only 33.351 ton in 2012 (Dinas Pertanian Provinsi Bengkulu, 2013). Low production may be due to unsuitable varieties, inefficient technology practiced by farmers, and insect pest damage (Purwati, 2007). Most of superior varieties are adapted to highland area, such as variety Berlian, Mutiara, and Kada (Wijayani and Widodo, 2005). The use of high yielding varieties but only adapted to highland has neglected local adapted varieties that might importance for future varieties improvement for wider adaptation.

Accession in this article is defined as the local variety collected from certain localities, maybe locally adapted variety or local variety. Local Bengkulu tomato accession is tomato plants that has been grown for years, but not known the parent materials. Grows and yield performance of local accessions varies among local accessions, such as morphology performance, flowering and harvesting ages, yield potential, and yield quality, and as such selection is needed. Selection is precided with characterization of specific character of local accession(Syukur *et al.,* 2009). Character variability occurring in local varieties is important to plant breeders as they might be useful for improving varieties. The objective of this

research is to determine and group characters of tomato accessions that can be used in tomato breeding program.

MATERIALS AND METHODS

This research was conducted in farmer field at Lingkar Barat, Bengkulu City in October 2013 - January 2014. This study included 10 local accessions of tomato found in Bengkulu for characterizing and grouping them, namely; Kepahiang 1 (K-1), Kepahiang 2 (K-2),City1 (C-1), City2 (C-2), Rejang Lebong 1 (RL-1), Rejang Lebong 2 (RL-2), Rejang Lebong 3 (RL-3), South Bengkulu (SB), Seluma (S), and North Bengkulu (NB). They were grown in polybags and arranged in randomized complete design (RCD) with 4 replications.

Tomato seed of all accession were grown in nursery in small polybag (10 cm x 8 cm) fiiled with organic soil until ready for transplanting (3 week age). Five seeds were sewedin each polybag.Irrigation, weeding, and pest control were done as necessary.Seedlings were transplanted into larger polybags (50 cm x 40 cm) filled with 10 kgsoil - chicken manure - and rice hull mixed with ratio 2:1:1. The plants were fertilized one week after transplanting with Urea, TSP, and KCl at dosis of 200, 200, and 100 ha^{-1}, (equal to 5, 5, and 2.5 g perpolybag, respectively). Replacement of death plants, watering, stand sticking, weeding, sucker removement, and pest control was done as necessary.

Observations were done weekly to record qualitative and quantitative characters such as colors of hypocotyl, leaves color, young fruits color, ripened fruits color, growth type, plant height, flowering and harvesting ages, fruit size (diameter, horizontal cross-section of fruit, and fruit locul partition), fruit hardness, fruit numbers per bunch, number of fruit bunches per plant, fruit numbers per plant, fruit weight of each, and fruit weight per plant. Qualitative characters were observed by scoring based on Departemen Pertanian Republik Indonesia (2007), and International Plant Genetic Resources Institute (IPGRI, 2007). Scoring was used for cluster analysis. Fruit harvestings were done when fruit color turn from green to yellowish red.

RESULT AND DISCUSSION

Variation in qualitative and quantitative characters were observed among 10 local tomato accessions found in Bengkulu, as a result of genetic variability. Variability of some characters seems to associate to other character.

At emergence in nursery there were two color of hypocotyl, green and purple (Table 1).Green hypocotyl belongs to accessions K-1and 2, RL-1, RL-2, and RL-3, and purple hypocotyl belongs to SB, S, C, and NB. Purple color hypocotyl caused by presence of anthocyanin (Bosland and Votava, 2000). Hypocotyl color seems to associate with flowering and harvesting age of tomato. Purple color associate with shorter flowering and harvesting ages, whereas,green color associate with longer ones.

There were three types plant growth performed by 10 studied accessions, determinate, semi-determinate, and indeterminate. K-2 and Sare determinate; the plant appearance are short (80 – 100 cm height) and produce fruit bunch at all nodes and at the top, with short harvesting time. Indeterminate type found in accession of K-1, C-1, C2, RL-1, and SB. They appearance are taller (>100 cm height). Fruit bunch produced at intermittent positions within 2-3 nodes. Harvesting time of those accessions are longer. Semi-determinate type is mixed-appearance between determinate and indeterminate (Fitriani, 2012). Semi-determinate type of tomato was short and no fruit bunch at the top. Semi-determinate type

belongs to accessions of RL-2, RL-3, and NB(Table 1). In general, farmers tend to prefer indeterminate type of tomato, mainly due to longer harvesting period and better fruit appearance (Prahasta, 2009). Plant height of K-1, RL-1, C-2, and SB are significantly higher than that of RL-2, RL-3, C-1, S, and NB accessions.

Overall, accessions K-1, K-2, RL-1, RL-2, and RL-3have longer flowering and harvesting age than the others (Table 1). This indicates that six aforementioned accessions might be more adapted to higher elevation. In contrast, four other accessions are more adapted to low elevation. Prahasta (2009) stated that tomatoes grown in low elevation are earlier reaching harvesting age than those grown in high elevation.

Table 1. Qualitative character of 10 local Bengkulu accessions based on hypocotil color, growth type, leaf color, flowering age, and harvest age.

Accession	Hypocotyl color	Growth type	Leaf color	Flowering age	Harvest age
K-1	Green	Indeterminate	Dark green	Long	Long
K-2	Green	Determinate	Dark green	Long	Long
C-1	Purple	Indeterminate	Dark green	Short	Short
C-2	Purple	Indeterminate	Dark green	Short	Short
RL-1	Green	Indeterminat	Dark green	Long	Long
RL-2	Green	Semi- determinate	Dark green	Long	Long
RL-3	Green	Semi- determinate	Dark green	Long	Long
SB	Purple	Indeterminate	Green	Short	Short
S	Purple	Determinate	Dark green	Short	Short
NB	Purple	Semi- determinate	Dark green	Short	Short

Except accession SB that has light green color, nine others have leaf with dark green color. In general, different leaf coloration among varieties is a phenotypic expression of genetic makeup.

Phenotypic variability was observed occurred on fruit coloration, shape and size. Fruit coloration varies among accessions, both of young and mature (ripe) fruits. The color of young fruit varies from whites-green to light green to green, while it varies from yellows-red to bright red to dark red (Table 2). Because fruit coloration is affected by the presence of chlorophyll in young, and of lycopene (for red color) and carotenoid (for yellow color)in ripe fruits, it must be genetically controlled as well as affected by microclimate (Maršić *et al*., 2009).

Color change in mature fruits is an indicator of the degree of frit ripening. In addition, the color itself is may be associated with A vitamin contain in in different varieties. Bright red color is usually associated with high vitamin A in fruit (Wiryana, 2000). Ten local accessions studied showed high variation in fruit size, ranging from very small to big (Table 2). Fruit diameters range from 4.8 – 7.8 cm. Fruit size of accession C-1 and NB are significantly higher than that of eight others, while of K-2 significantly different with C-1 and S (Table 3). General consumers in Indonesia tend to prefer big size tomato (Purwati, 2007).

Phenotypic variation among accessions also found in fruit harness, as it expressed in $kgfcm^{-2}$unit. Accession K-1, K-2, RL-1 and RL-2 have significantly higher value of hardness than those others. K-1 is the highest and NB is the lowest. Physical hardness of tomato fruit is associated with firmness of skin and flesh, and is genetically controlled (Radzevičius *et al*., 2013). Fruit hardness is one of character considered by consumers. Consumers in Indonesia

tend to prefer fruits with medium firmness of flesh and hard skin (Ambarwati *et al*., 2009; Purwati 2007).

Table 2. Qualitative character of 10 local Bengkulu accessions based on young fruit color (YFC), ripened fruit color (RFC), ripened fruit size (RFS), horizontal cross-section of Fruit (HCS), fruit locul partition (FLP)

Accession	YFC	RFC	RFS	HCS	FLP
K-1	Whities green	Bright red	Medium	Egg shape	Round
K-2	Bright green	Bright red	Big	Egg shape	Round
C-1	Whities Green	Soft red	Very small	Round	Angular
C-2	Green	Soft red	Small	Slim	Irregular
RL-1	Bright green	Bright red	Big	Breech egg shape	Round
RL-2	Whities green	Bright red	Medium	Egg shape	Round
RL-3	Brightgreen	Soft red	Medium	Slim	Irregular
SB	Green	Soft red	Small	Slim	Irregular
S	Green	Soft red	Medium	Round	Irregular
NB	Whities green	Soft red	Very small	Round	Angular

Fruit bunch, fruit number per bunch and fruit number per plant differ significantly among accessions. Fruit bunches are significantly more numerous on C-1 than that on others accessions, while those of 9 other accession do not differ significantly. Fruit number per bunch as well as per plant is significantly higher on C-1 and NB than that of 8 other accessions (Table 3). Fruit weights also vary among accessions with C-1 and NB being the least and significantly lower than that of eight other accessions. There are negative correlation between fruit number per bunch and fruit number per plant with fruit weight. Accessions with high fruit number per bunch and fruit number per plant have lower fruit weight. The variations in all aforementioned character above do not result in fruit weight per plant, which do not differ significantly, even though K-2 is twice or more and RL-1 and S are almost twice as higher than other accessions.

Cluster analysis on scoring of fruit characters (shape, color, and size) resulted in grouping of accession into three clusters as showed in dendrogram. The first cluster includes K-1, K-2, RL-1, and RL-2, with egg shape, bright red color, and medium - large size. Accession C-1 and NB were in the second cluster characterized by round shape, soft-red color and small size. The third cluster includes C-1, SB, Sand RL-3; with character of curly shape, soft-red color and medium size fruits (Figure 1).

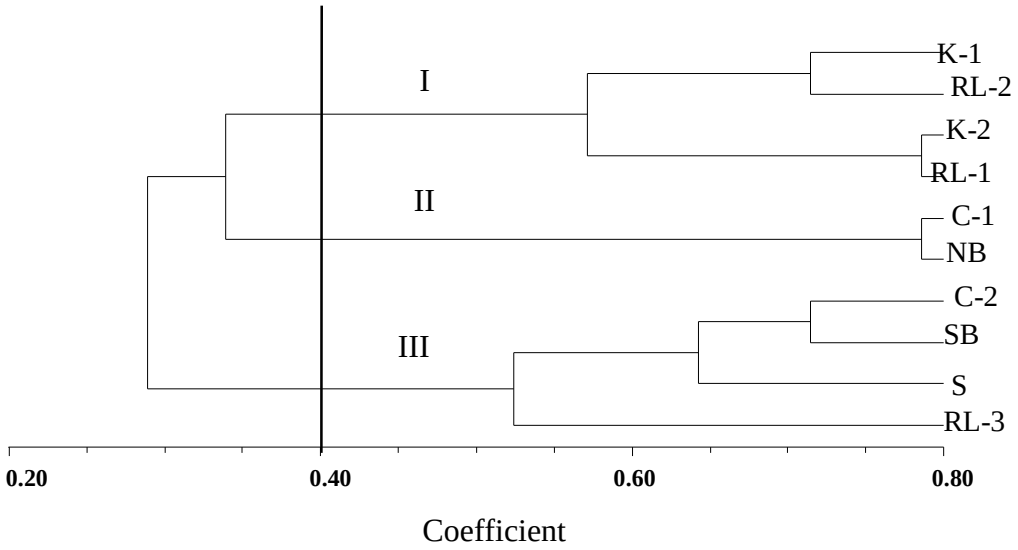

Figure1. Dendrogram based oncharacter qualitative closeness of ten local Bengkulu tomato accession.

Mathrycs of similarity correlation value MxComp is 0,846, indicating that the dendogram made of *goodness of fit* grouping 10 accessions. Jantje (2011) stated that cluster analysis migh be interpretated that closeness depend on the grade dendrogram coefficient the higher coefficient, the closer relationship between them due to the similarity in some characters.

Table 3. Means of some variables of ten tomato accesssions[1)]

Accession	Plant height (cm)	Fruit diameter (mm)	Fruit hardness ($kgfcm^{-2}$)	Bunch per plant	Fruit number per bunch	Fruit number per plant	Weight per fruit (gram)	Fruit weight per plant (kg)
K-1	117.3^{a}	66.2^{ab}	2.1^{ab}	4.5^{b}	3.8^{c}	24.0^{c}	81.9^{ab}	1.3^{a}
K-2	103.9^{abcd}	67.5^{a}	2.4^{a}	5.3^{b}	3.8^{c}	43.6^{bc}	91.3^{a}	2.3^{a}
C-1	97.0^{bcd}	48.1^{c}	1.3^{d}	20.3^{a}	8.5^{a}	172.3^{a}	11.0^{e}	1.2^{a}
C-2	120.6^{a}	56.8^{bc}	1.4^{cd}	8.3^{b}	3.0^{c}	78.9^{b}	37.2^{d}	1.1^{a}
RL-1	110.6^{ab}	65.7^{ab}	2.1^{b}	7.3^{b}	5.8^{b}	45.2^{bc}	66.0^{bc}	1.9^{a}
RL-2	87.8^{d}	63.3^{ab}	1.6^{b}	5.8^{b}	2.5^{c}	27.3^{bc}	79.6^{ab}	1.2^{a}
RL-3	95.7^{bcd}	52.6^{bc}	1.4^{cd}	7.8^{b}	3.8^{c}	50.8^{bc}	38.3^{d}	1.3^{a}
SB	107.0^{abc}	56.5^{bc}	1.4^{cd}	6.8^{b}	3.3^{c}	56.0^{bc}	35.9^{d}	1.2^{a}
S	96.0^{bcd}	62.9^{b}	1.5^{c}	7.8^{b}	3.8^{c}	71.0^{b}	47.8^{cd}	1.8^{a}
NB	91.0^{cd}	48.1^{c}	1.3^{d}	10.3^{b}	7.3^{ab}	177.8^{a}	13.6^{e}	1.1^{a}

1) Means followed by the same small letter are not significantly different ($P>0.05$); while means followed by different small letters are significantly different ($P<0.05$)

Coefficient similarity at 0.40 produces three clusters that generally can be seen based on fruit appearance (shape, color, size). First cluster (I) has egg shape, bright red color, and medium size to large size; they are accessions of K1, RL-2, K-2 and RL-1. The second cluster (II), has round shape, soft red color, and size very small; they are accessions of C-1 and NB, and the third cluster (III), has curly shape (curved), soft red colored, medium size and they are in four accessions C-2, SB, S, andRL-3 (Figure 1).

Based on qualitative and qualitative accessions of Bengkulu local accessions, there is a good reason to suggest that six tomato accessions which are K-1, K-2, C-1, RL-1, RL-2, and NB might be used in tomato breeding program based on criteria of plant height, flowering age, harvest age, fruit appearance (color, shape, size), fruit hardeness, fruit diameter, fruit numbers per bunch, number of fruit bunches per plant, fruit numbers per plant, fruit weight of each, and fruit weight per plant

CONCLUSION

The investigations revealed that local tomato accessions differed from each other with respect to qualitative and quantitative growth, production, and fruit characters. Plant height was higher in tomato with indeterminate than in tomato with determinate type of growth. All the characters are no doubt genetically control, though there are environmental influences. The ten accessions were grouped into three clusters; the first includes K-1, K-2, RL-1 and RL-2; the second includes C-1 and NB; and the third cluster contains C-2 and SB, S, and RL-3. Six tomato accessions, K-1, K-2, C-1, RL-1, RL-2, and NB might be used in tomato breeding program based on criteria of plant height, flowering age, harvest age, fruit appearance (color, shape, size), fruit hardeness, fruit diameter, fruit numbers per bunch, number of fruit bunches per plant, fruit numbers per plant, fruit weight of each, and fruit weight per plant.

REFERENCES

Ambarwati, E., G.A. Putu., dan R.H. Murti. 2009. Mutu buah tomat galur\harapan keturunan GM3 dengan Gondol Putih. hlm. 273-282. Prosiding Seminar Nasional Hasil Penelitian Pertanian. Yogyakarta.

Bosland, P. W. and E. J. Votava. 2000. Peppers: Vegetable and Spice *Capsicums.* CABI Publishing. New York. 204 ps.

Departemen Pertanian Republik Indonesia. 2007. Panduan pengujian individual kebaruan, keunikan, keseragaman dan kestabilan. Pusat Perlindungan Varietas Tanaman. http:/*ppvt.setjen.deptan.go.id/ppvtnew/files/14PPI%20tomat.pdf.* Diakses 9 September 2013.

Dinas Pertanian Provinsi Bengkulu. 2013. Data Produksi Tomat Provinsi Bengkulu 2013. Dinas Pertanian Provinsi Bengkulu, Bengkulu.

Fitriani, E. 2012. Untung Berlipat Budidaya Tomat di Berbagai Media Tanam. Pustaka Baru Press, Bandung.

International Plant Genetic Resources Institute (IPGRI). 2007. Descriptor for Tomato (Lycopersicon spp.) In a Global Report. José T. Esquinas-Alcazar. AGP: IPGRi/80/103/. IPGRI Secretariat, Rome. 65p

Jantje, P. 2011. Penampilan beberapa varietas tomat pada dua kondisi lingkungan. J. Eugenia. 17(2):146-155.

Maršić, N.K., L. Gašperlin, V. Abram, M. Budič, R. Vidrih. 2011. Quality parameters and total phenolic content in tomato fruits regarding cultivar and micro climatic conditions. Turk J. Agric For. 35: 185-194. doi:10.3906/tar-0910-499.

Prahasta, A. 2009. Agribisnis Tomat. CV Pustaka Grafika, Bandung.

Purwati, E. 2007. Pemuliaan tanaman tomat dalam teknologi produksi tomat. Bandung. Balai Penelitian Tanaman Sayuran. Pusat Penelitian dan Pengembangan Hortikultura, Badan Penelitian dan Pengembangan Pertanian 369:269-284.

Radzevičius, A., P. Viškelis, J. Viškelis, R. Bobinaitė, R. Karklelienė, and D. Juškevičienė. 2013. Tomato fruit quality of different cultivars growth in Lithuania. Intl. J. Biol., Biomol., Agric., Food and Biotechnol. Engineering 7 (7): 708-711.

Syukur, M., S. Sujiprihati, dan R. Yunianti. 2009. Teknik Pemuliaan Tanaman. Departemen Agronomi dan Hortikultura. Fakultas Pertanian, Institut Pertanian Bogor. Bogor.

Wijayani, A, & Widodo, W. 2005. Usaha meningkatkan kualitas beberapa varietas tomat dengan sistem budidaya hidroponik. J. Ilmu Pertanian Indonesia. 12 (1):77.

Wiryana, B.T. 2000. Bertanam Tomat. Agro Media Pustaka, Jakar