Adaptation test of five introduced cherry tomato lines in Lembang highland

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Abstract. Tomato has some types according to fruit size and shape, one of them is cherry tomato. The purpose of this research was to select and evaluate five introduced cherry tomato lines in Lembang highland that have good potential to be developed as a new variety refer to result of the adaptation and consumer preferences test. The research material consisted of introduced lines IJR 151, IJR 154, IJR 1150, IJR 1158, IJR 2170 and one local variety as a check genotype. The adaptation and preference consumer test conducted at Indonesian Vegetables Research Institute, Lembang (1,250 m sal) from March until August 2017. The research used a Randomized Complete Block Design (RCBD) with three replications. Research result showed that all cherry tomato lines could adapt well in Lembang. IJR 151 and IJR 154 lines could be developed as a new variety refer to consumer’s preference test on fruit shape and taste parameter, eventhought IJR 1158 and IJR 2170 lines had higher fruit weight. Furthermore IJR 154, IJR 1150, IJR 1158 lines could be recommended to provide and overcome sufficiency vitamine A and C due to their high beta carotene content (> 100 microgram mg⁻¹).

1. Introduction.
Tomato (Lycopersicon esculentum Mill.) derived from South America [1] and as one of popular vegetable crop because it has high nutritional content [2]. In Indonesia tomato is widely cultivated in both highland and lowland [3]. Grubben (1990) [4] stated that on Java island mostly tomato cultivation was in highland (60%), whereas in lowland area only 40%. According to Indonesia horticultural statistic data showed that tomato production in 2019 was 1.020.333 ton (18.63 t ha⁻¹) or increase 1.15% with province of West Java, North Sumatra, West Sumatera, East Java, and South Sulawesi as centre of production [5].

There are some tomato types according to fruit size and shape, one of them is cherry tomato [6]. Actually cherry tomato had long been known in Indonesia, but the cultivation still not popular yet among farmers. One of reluctance factor to cultivate it is frequent harvesting and price fluctuation thus considered less profitable economically [7].

Kumari et al.(2017) and Diaz (2012) [8] [9] stated that cherry tomato as a main source of vitamin C and B complex in form of beta carotene, thiamin, niacin, riboflavin, and various important minerals for human nutrition i.e. calcium (Ca), phosphor (P), iron (Fe), and potassium (K). Unfortunately the added value of cherry tomato has not been utilized yet by Indonesian’s consumers. They only consume cherry tomato occasionally as a fresh table fruit. Eventhough Slimestad and Verheul (2005) [10] informed that inside of each 100 g cherry tomato could produce 19 cal.
The opportunity for cherry tomato promotion can be increased in line with arise public awareness on importance nutritional content for health [11], so it is expected the commodity will be economically profitable. Hanson (2003) [12] stated that cherry tomato with high beta carotene content could be developed to overcome vitamin A and C deficiencies that were common in African and Asian countries. Some research institutions such as the Asian Vegetables Research Development Center (AVRDC) have released several cherry tomato lines with beta carotene content of 3-12 times compared to common. Likewise, some introduced cherry tomato lines were reported also to have high nutritional content, but should be verified first by adaptation and preference consumer test.

The purpose of this research was to select and evaluate five introduced cherry tomato lines that have good potential to be developed as a new variety refer to result of the adaptation and consumer preferences test.

2. Methods
The adaptation and preference consumer test conducted at Indonesian Vegetables Research Institute, Lembang (1,250 m sal) from March until August 2017. The research used a Randomized Complete Block Design (RCBD) with three replications. The research material consisted of introduced lines IJR 151, IJR 154, IJR 1150, IJR 1158, IJR 2170 and one local variety as a check genotype.

The seeds were soaked warm water at 30-40°C for 15-20 minutes before sown. Then the seeds were treated fungicide Benlate with recommendation dosage. The seeds were planted in the plastic pots with mixed media composition soil with chicken manure (1 : 1) and kept at the nursery place. The seedling could be transplanted in the field at 3 weeks age after sown.

Land preparation included of basic fertilizer application with dosage 30 t manure, 35 kg urea, 75 kg Zn, 125 kg SP 36 and 100 kg KCl per ha [13]. The subsequent fertilizer was applied at age 14 and 30 days after planting (DAP) with dosage 300 kg ha⁻¹ NPK (15-15-15) per application. The land was covered by silver plastic mulch with spacing 50 x 70 cm. The population was 20 plants / line / replication until total was 450 plants. Replanting was carried out 7 DAP to change the damaged or died seedling. The plant maintaining included of weeding, watering, subsequent fertilizing, pest and disease protecting, and harvesting.

The observation parameter was carried out to percentage of plant survives in the field (%), plant height (cm), flowering time (DAP), fruit number per clusters (unit), fruit number per plant, fruit weight per plant (g), fruit diameter (cm), and beta carotene content of each line (µg/mg). The parameter data was analized by F test and DMRT test at level 5%.

Preference consumer test was carried out to 50 respondens. The obtained scoring refered to preferred percentage by responden with criteria of shape and taste. The lowest scoring indicated a high preference level.

3. Results and discussion
3.1. Percentage of survive plant in the field
The observation result in the field showed that all lines had survive plant percentage was more than 90.00% (Table 1). This indicated that all the introduced lines could adapt well in Lembang highland. Possibility they all had a genetic background as heat tolerant genotypes. It was not surprisingly because some research institutes such as AVRDC had developed many kind of vegetables including cherry tomato for tropical contries [14]. Recent vegetable cultivation in Indonesia had been focussed to lowland or medium due to environment’s damage in highland caused by agriculture activity or residency, eventhough these area actually as a conservation region for water supply. Therefore if availability heat tolerant lines, they could be developed for lowland or medium area which both of them have higher temperature [15]. Thus environmental sustainability in highland area can be maintained.
Table 1. Adaptation test results of five introduced cherry tomato lines in Lembang highland

| Lines    | Survive plants (%) | Flowering time (DAP) | Plant height (cm) | Flwr number /inflorescence (flowers) | Fruit number/pl (fruits) | Fruit weight/pl (g) | Fruit diameter (cm) | Beta carotene content (µg/mg) |
|----------|--------------------|----------------------|-------------------|--------------------------------------|--------------------------|---------------------|---------------------|-------------------------------|
| IJR 151  | 100.00             | 58.67                | 37.24 a           | 13.13 ab                             | 770.35 b                 | 4410.65 bc          | 1.75 d              | 85.190                        |
| IJR 154  | 93.33              | 57.60 bc             | 35.67 a           | 15.53 a                              | 1010.00 a                | 4890.65 bc          | 1.70 d              | 101.770                       |
| IJR 1150 | 96.67              | 58.20 abc            | 31.55 ab          | 14.60 ab                             | 721.25 b                 | 5751.00 b           | 2.25 c              | 102.287                       |
| IJR 1158 | 90.00              | 57.33 c              | 37.45 a           | 14.00 ab                             | 602.50 b                 | 8080.65 a           | 3.00 b              | 102.166                       |
| IJR 2170 | 100.00             | 58.67 bc             | 28.67 bc          | 11.40 b                              | 355.30 c                 | 7820.00 a           | 3.80 a              | 73.648                        |
| Local    | 100.00             | 60.50 a              | 23.45 c           | 8.10 c                               | 197.50 c                 | 1720.33 d           | 1.65 d              | 95.959                        |
| CV (%)   | 2.52               | 9.65                 | 12.75             | 17.45                                | 15.50                    | 7.50                |                     |                               |

Note: Mean followed by the same letters on the same columns are not significantly according to Duncan’s multiply range test at 0.05 level

3.2. Flowering time
In the Table 1 could be known that the flowering time of all cherry tomato lines was around 57-61 days after planting (DAP). IJR 1158 (57.33 DAP) was the earliest eventhough not different significantly with four other lines, i.e. IJR 154 (57.60 DAP), IJR 1150 (58.20 DAP), IJR 2170 (58.67 DAP), IJR 151 (58.67 DAP). These data correlated also with their harvesting time. Generally if one genotype has earlier flowering time, so it will be earlier harvested also. This condition had some advantages i.e. low budget for cost production input and profitable economically. Plant genotypes with early maturity trait also can be implemented to solve pest and disease infection problem because they can stop life cycle of pest-diseae naturally, beside that they can avoid of drought condition with earlier complete biologically life cycle before dry season coming [16].

3.3. Plant height at flowering time
The introduced cherry tomato lines had average of plant height were higher than local line. This caused all introduced lines were indeterminate type. Plant height of IJR 1158 line (37.45 cm) was the highest eventhough not different significantly with three other lines i.e. IJR 151 (37.24 cm), IJR 154 (35.67 cm), IJR 1150 SA (31.55 cm). Commonly indeterminate type has stem is slimmer, but higher because on the main stem will appear and develop upper side branches [17], hence be needed many sticks for their cultivation [18]. The fruit quality of cherry tomato is still good enough as long maintained well in the cultivation. Thus the prunning technique can be implemented also in this case [19] [20].

3.4. Flower number per inflorescence and fruit number per plant
IJR 154 was the most of flower number per inflorescence (15.53 flowers) eventhough not different significantly with three other lines i.e. IJR 1150 (14.60 flowers), IJR 1158 (14.00 flowers), IJR 151 (13.13 flowers ). The consequence of this data was IJR 154 (1010 fruits/plant) also as the most of fruit number per bed compared with other lines. Usually there was a correlation between fruit number parameter with fruit production. As much more as fruit number, it will increase the production also [21].

Generally cherry tomato has more than 10 flowers or fruits per inflorescence. This character can be used also to improve a plant genotype in the breeding program. Using cherry tomato as a male parent crossed with common tomato are expected to be order to inherit trait of flower number per inflorescence or fruit sets [22]. Murti et al. (2004) [23] informed that flower number per inflorescence, fruit set, and fruit locule number are quantitative character that controlled by monogenic, therefore it can be easily inherited to their offspring.
3.5. Fruit weight per plant and fruit diameter size

In the Table 1 could be seen that IJR 151 was the most of fruit number per plant performance, but in the fact the heaviest of fruit weight was obtained by IJR 1158 (8080.65 g/plant), eventhought not different significantly with IJR 2170 (7820.00 g/plant). This result proved that fruit diameter size of IJR 154 was smaller performance than IJR 1158 and IJR 2170 lines. Thus eventhought both of the lines were fewer of fruit number parameter than IJR 145, but their fruit diameter size were bigger, therefore automatically they were heavier even if compared with other lines. Result of correlation analyze showed that play fruit diameter size ($R^2 = 0.450$) role was much more than fruit number ($R^2 = 0.238$) in determining fruit weight performance. The result also showed there was a possitive correlation between fruit weight parameter as a dependent variable with fruit number and diameter size as independend variable (Fig. 1 and 2).

![Figure 1. Correlation between fruit number parameter (X) with fruit weight parameter (Y) on cherry tomato lines](image1)

![Figure 2. Correlation between fruit diameter size (X) with fruit weight (Y) on cherry tomato lines](image2)
3.6. Consumer’s preference test

IJR 2170 and IJR 1158 lines were cherry tomato type with bigger diameter size. Nevertheless in the fact fruit diameter size and fruit weight of cherry tomato are not entirely as the preferred characters by consumer. There are some other criteria to be selected by respondents, in this case are fruit shape, fruit taste, fruit hardness, fruit color, etc [24].

Vitamin dan mineral of cherry tomato content also become one of criteria selected by consumers [24]. In the Table 1 could be seen that IJR 154, IJR 1150, IJR 1158 lines had higher beta carotene content (> 100 \( \mu g \) mg\(^{-1} \)) than local genotype (46.166 \( \mu g \) mg\(^{-1} \)). This data information could recommend the cherry tomato lines which could be consumed to fulfill and overcome sufficiency vitamine A and C. Necessity of vitamine C for daily is around 60 mg [30], but there is a variation of each individual. Some cases of physical stress such as burns, infection, heavy metal poisoning, smoking, constantly drugs, etc can increase the body’s necessity for vitamine C. Furthermore the smookers need vitamin C around 100 mg per daily [25].

| Parameter  | IJR 151 | IJR 154 | IJR 1150 | IJR 1158 | IJR 2170 | Local | Total |
|------------|---------|---------|----------|----------|----------|-------|-------|
| Shape (%)  | 16 (32.00) | 10 (20.00) | 7 (14.00) | 8 (16.00) | 3 (6.00) | 6 (12.00) | 50     |
| Scoring    | 2        | 2        | 4        | 3        | 6        | 5     |       |
| Taste (%)  | 12 (24.00) | 14 (28.00) | 7 (14.00) | 10 (20.00) | 2 (4.00) | 5 (25.00) | 50     |
| Scoring    | 2        | 1        | 4        | 3        | 6        | 5     |       |
| Total      | 3        | 3        | 8        | 6        | 12       | 10    |       |

In the Table 2 could be informed that the preferred cherry tomato lines by 50 respondents were IJR 154, IJR 151, IJR 1158, IJR 1150, local genotype, IJR 2170 respectively. Certainly this information was very important to be order to select cherry tomato lines which could be developed in the future. At the end the cherry tomato cultivation will be profitable economically.

| Characters                  | IJR 151 | IJR 154 | IJR 1150 | IJR 1158 | IJR 2170 | Local |
|-----------------------------|---------|---------|----------|----------|----------|-------|
| Immaturity fruit color      | Green   | Light green | Light green | Green | Dark | Light green |
| Mature fruit color          | Red     | Orange | Orange | Orange | Red | Orange |
| Shape of fruit tip          | Flat    | Intended | Flat    | Slightly depressed | Slightly depressed | Flat |
| Pedicel area                | Slightly depressed | Flatt | Slightly depressed | Slightly depressed | Slightly depressed | Flat |
| Fruit shape                 | Pear    | Lengthened cylindrical | Pear | High round | High round | High round |

4. Conclusion and Suggestion

Research result showed that all cherry tomato lines could adapt well in Lembang. IJR 151 and IJR 154 lines could be developed as a new variety refer to consumer’s preference test on fruit shape and taste parameter, eventhought IJR 1158 and IJR 2170 lines had higher fruit weight. Furhermore IJR 154, IJR 1150, IJR 1158 lines could be recomended to provide and overcome sufficiency vitamine A and C due to their high beta carotene content (> 100 \( \mu g \) mg\(^{-1} \))

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