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Evaluation of Some Genotypes of Guava Trees (*Psidium guajava* L.) for Yield and Fruits Quality in Dakahlia Governorate, Egypt

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Abstract: The evaluation and introduction of new guava genotypes with important trails for breading are very important for guava growers. The experiment was carried out during two growing seasons (2016 and 2017) to evaluate some morphological and productivity characteristics of thirteen genotypes of seedy guava trees with about 22 years old, grown in Baramoon experimental farm, horticulture research institute Dakahlia governorate, Egypt. This evaluation included vegetative growth, yield and quality of fruits. Results showed that all studied characters revealed significant differences among 13 tested genotypes. The genotype 8 was found superior on over all genotypes, in terms of yield (68.02 kg/tree), fruit number 602 fruits, fruit weight (113 g), fruit volume (99.22 ml), fruit length (8.3 cm), fruit diameter (7.3 cm), pulp thickness (2.33 cm), seed weight to fruit weight ratio (1.42 %), firmness (4.51 Kg/cm^2), total soluble solids (TSS) (13.34 °Brix), titratable acidity (TA) of guava fruit (0.29 %) and ascorbic acid or vitamin C (98.52 mg/100g) and is recommended to be propagated and distributed to growers.

Key words: Evaluation · Guava · Genotypes · Yield · Quality

INTRODUCTION

Guava (*Psidium guajava* L.) (Myrtaceae) is an important fruit crop in different parts of the world and its fruit is much appreciated for its nutritional properties [1]. The most important guava fruit producers are India, Mexico, Brazil, Egypt, South Africa and Colombia. In these countries guava fruit production has increased 10 fold in the last five years [2, 3]. In Egypt, guava occupies a cultivated area of 37343 faddans with an annual production of 339520 tones of fruits, according to the recent statistics data provided by the Ministry of Agriculture in 2018 [4].

Guava shows broad morphologic and productive variation due the crop is commonly sexual-propagated. The characterization of genetic diversity of guava germplasm will allow identify potential parents for genetic improvement as well as the production of new clonal cultivars [5-7].

In Egypt, the Horticulture Research Institute (HRI), Agricultural Research Center (ARC) has released a good number of guava genotypes which has been grown in the country. It is touch stone to a breeder to evolve high yielding varieties through selection from the existing genotypes. Bassateen El Sabahia, Bassateen Edfina and Maamoura are new local varieties selected from seedling progeny for propagation on commercial basis [8]. They are characterized by high yield and good fruit quality. Also, recent breeding program has release new cultivars, which differs in fruit composition and possible uses [7].

As guava is an important fruit crop, it is necessary to characterize the better genotypes out of the existing material available in Egypt and characterize them for growth, yield and quality, for their identification and further use in improvement programs. Therefore, the present study was undertaken at Baramoon experimental farm, horticulture research institute Dakahlia governorate, Egypt to characterize the different genotypes of guava germplasm on the basis of morphological, yield and quality parameters and to find out the best suited genotypes.

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Table 1: Mean physical and chemical characteristics of the experimental soil site at the beginning of experiment 2016.

Properties	Values	Properties	Values
Sand (%)	27.6	Ca^{2+} mg/kg soil	324.1
Silt (%)	31.7	K^{+} mg/kg soil	421.2
Clay (%)	40.7	Na^{+} meq/l	13.92
Texture class	Clay- loam	Mg^{2+} mg/kg soil	1103.38
Organic matter %	1.09	P mg/kg soil	3.36
CaCO3	17.5	Cl^{-} meq/l	17.64
pH	7.8	$SO4^{-}$ meq/l	39.15
E.C. (dSm^{-1})	1.5	Zn mg/kg soil	0.99
Total N mg/kg soil	99.8	Fe mg/kg soil	24.52

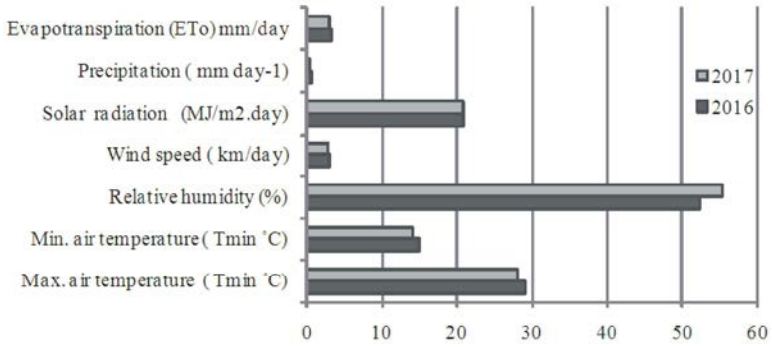

Fig. 1: Average of annual weather data of the experiment site at Dakahlia governorate, Egypt during the period 2016-2017 growing seasons.

MATERIALS AND METHODS

The study was carried out during 2016 and 2017 at Baramoon experimental farm, horticulture research institute Dakahlia governorate, Egypt on thirteen guava genotypes selected from 37 genotypes of guava trees (*Psidium guajava* L.). The experimental trees were about 22 years old, planted at 5×5 m, free from pathological and physiological disorders. The trees were irrigated with superficial irrigation, soil physical and chemical analysis is shown in Table (1).

The average of annual maximum air temperature, minimum air temperature, wind speed, relative humidity, solar radiation and evapotranspiration (ETo) for study locations during the period 2016-2017 were obtained from the website o f the America's space agency (NASA https:// power.larc.nasa.gov/ data-access-viewer/). Respect to the evapotranspiration (Eto) data was calculated using the FAO Penman-Monteith equation as described by Allen *et al.* [9] Figure (1).

Vegetative Growth Parameters

Tree Height (m) was recorded from ground level to the tip of the terminal shoot in meters with the help of measuring tape.

Stem Girth (cm): Was recorded with the help of measuring tape at above 25 cm from the ground level and average was calculated.

New Shoot Length (cm): Four new shoots almost uniform is their diameters were randomly labeled on different tree direction on mid May. Average new shoot length (cm) at end of august was recorded.

Leaf Shape: Mater leaves were visually observed to record the shape. The shape of fruit was recorded as ovate, obvate, oblong, trullate-shaped and obtrullate.

Canopy Volume (m^3): Was calculated in (m^3) by formula given by Roose *et al*. [10] as V = 4/6 πhr2 Where, h= height of tree (m) and r = Sum of E-W and N-S directions (m)/4 E-W= East-West; N-S= North-South.

Leaf Area (cm^2): Mater leaves (on the third -node from the base of the previously tagged non-fruiting shoots), were collected on mid august at the end of the spring flush. Leaf length, width and surface area were measured to find out the average leaf area according to (Chou, [11] by using the following equation:

Leaf area (cm3) = (2/3 x leaf length × leaf width).

Flowering and Setting Parameters: During both seasons of the study four main branches well distributed within the tree canopy and similar in their diameter were selected and tagged.

Initial Flowering Date: Appearance of 20 number of flowers in a particular date during initial phase of flowering was recorded as the date of first flowering, when the first flower bud start to opening, the date of start flowering was noted.

Full Bloom Date: Appearance of maximum number of flowers in a particular date was recorded as the date of full blossom.

End Flowering Date: Appearance of 20 number of flowers in a particular date towards last phase of flowering was recorded as the date of end of flowering.

Initial Fruit Set Date: Appearance of 20 number of fruits in a particular date towards last phase of flowering was recorded as the date of first setting.

Percentage of Fruit Set Two Weeks after Setting: On four main branches were calculated by the following equation: Percentage of fruit set (two weeks after setting)= total number of fruit set two weeks after setting / total number of flowers ×100.

Percentage of Fruit Set Two Weeks before Harvesting: on four main branches were calculated by the following equation: Percentage of fruit set two weeks before harvesting = total number of fruit set two weeks before harvesting / total number of flowers ×100.

Yield Parameters

Number of Fruits per Tree: Fruits was harvested after full maturity from each tree and the total number was recorded.

Yield (kg/tree): Was calculated by the following equation: average weight of fruit × total number of fruits per tree and yield per tree was calculated in kg.

Physico-Chemical Characteristics of Guava Fruits: 10 fruits from each tree were randomly taken and used for determination of both fruit physical and chemical characteristics as follows.

Fruit Weight (g): Was recorded on electronic balance and average weight of fruits was recorded in grams.

Fruit Length (cm) and Fruit Diameter (cm): Were measured by using Hand Vernier Caliper and average length and diameter of fruits were recorded in cm.

Fruit Volume (ml): Was estimated by water displacement method and expressed in ml.

Pulp Thickness (cm): To measure the thickness of pulp, the fruits were equally divided in to two pieces by cutting and length between skin and seedball was measured with the help of scale in centimeter.

Percentage of Seed Weight per Fruit: The weight of pulp was calculated by deducting the weight of seed from the total weight of fruit. Pulp percentage was calculated by using the following formula. Pulp percentage = Total weight of pulp/ Total weight of fruits× 100.

Firmness: Was determined in two guava fruits per genotype at two equatorial opposite sites by using a hand-held fruit firmness tester (Effegi, 48011 Alfonsine, Italy) equipped with an 8 mm cylindrical stainless steel plunger tip. Two readings were taken on the flesh of each fruit after peeling and data were expressed as kg/m^2 [12].

Total Soluble Solid (TSS %) of Pulp: Was measured by Hand Refractometer of 0-32 °Brix range at room temperature.

Titratable Acidity and Ascorbic Acid Content: Were determined by titration with standardized 0.1 N sodium hydroxide to a definite faint pink end point using 2, 6-dichlorophenol endophenol blue dye, as an indicator and acidity was expressed as percent citric acid and ascorbic acid as mg ascorbic acid/100 ml juice [7].

The data was statistically analyzed by Statistix 9.0 program (Analytical Software, Tallahassee, FL. USA). Mean values were compared by the Duncan's multiple range tests.

RESULTS AND DISCUSSION

An on-farm study was conducted to evaluate vegetative growth and yield and quality attributes of fruits of 13 guava genotypes. A wide range of variability in respect of growth, yield and quality attributes of fruits was recorded in evaluated guava genotypes. Out of 13 guava genotypes, the G8 topped the rest of genotypes in term of growth, yield and quality attributes of fruits.

Table 2: Data of Vegetative growth of guava trees (Pooled mean 2016 and 2017 seasons).

Genotypes	Tree height (m)	Canopy volume (m^3)	Stem girth (cm)	New shoot length (cm)	Leaf shape	Leaf area (cm^2)
1	3.75ab	38.47b	55.00ab	29.20ab	ovate	64.13b
2	3.50c	34.72bc	50.25b	28.90ab	ovate	58.70c
3	3.50c	34.43bc	49.00bc	28.78ab	obvate	53.60d
4	3.50c	34.14bc	47.30c	28.77ab	trullate	53.45d
5	3.70b	37.32bc	55.00ab	29.00ab	oblong	60.00c
6	3.50c	34.04bc	49.90bc	28.85ab	obvate	56.68c
7	3.00d	28.52c	47.10c	28.70ab	trullate	53.00d
8	3.77a	43.41a	57.00a	29.80a	trullate	69.20a
9	3.50c	33.95bc	50.20b	29.00ab	ovate	60.00c
10	3.00d	28.27c	40.50d	28.67ab	ovate	51.46d
11	2.80f	18.17d	37.60e	28.16b	ovate	50.70d
12	2.90e	23.46c	34.50f	28.35b	ovate	51.00d
13	3.00d	27.14c	43.20d	28.70ab	obtrullate	51.89d

Means in the same column followed by the same letter(s) are not significantly ($p \geq 0.05$) different.

Vegetative Growth Parameters: There were wide variations among different guava genotypes with respect to tree height, canopy volume, stem girth, new shoot length and leaf area Table (2). The genotype G8 was found superior on over all genotypes, in terms of tree height (3.77 m), canopy volume (43.41 m^3), stem girth (57.00 cm), new shoot length (29.80 cm) and leaf area (69.20 cm^2) which was closely followed by the genotype G1 with the tree height (3.75 m), canopy volume (38.47 m^3), stem girth (55.00 cm), new shoot length (29.20 cm) and leaf area (64.11 cm^2) as shown Table 1. Whereas, the genotype G11 had the lowest values of tree height (2.80 m), canopy volume (18.17 m^3), stem girth (37.60 cm), new shoot length (28.16 cm) and leaf area (50.70 cm^2) as given in the Table 2, similar findings were reported by, Abou El-Khasheb *et al*. [13], who found that, the guava genotype No. 64 gave significant increase in shoot length (23.5cm) compared with the other genotypes when mentioned they studied 11 above characteristics. El-Sisy [7] found that, tree height, new shoot length and leaf area were varied from (2.55 - 4.11 m), (19.94 -54.45 cm) and (30.67- 78.33 cm^2) respectively, when she studied 15 guava genotypes of five years old. Daljinder [14] found that, the stem girth was varied from 6.07 cm to 46.26 cm, when she studied 15 guava genotypes of five years old, when he studied 35 guava genotypes in India. Shiva [15] found that, the canopy volume was varied among different guava genotypes (1.19 - 42.88 m^3), when he studied 24 guava genotypes in India.

The tested genotypes in the current study differed in shape of leaf and most of them had obvate appearance. The leaf shape varied from obvate to trullate as shown Table (2). Similar variation in leaf shape has also been reported by Daljinder [14].

Flowering and Setting: Table (3) showed the initial of flowering date, full bloom date, end flowering date, initial fruit set date, fruit set percentage two weeks after setting and fruit set percentage two weeks before harvesting for selected thirteen genotypes of guava, in the two seasons (2016 and 2017).

Initial of flowering was observed in 2nd week of April, full bloom was observed in 1st week of May, end flowering was observed in 2nd week of June and initial fruit set was observed in 1st week of June in 13 genotypes of guava. The results are in harmony with those obtained by Daljinder [14], found that, date of first flower opening during summer season varied from 12th April (during 2011 and 2012) to 21st and 29th April during 2011 and 2012, respectively, end of flowering during 2011 was observed on 20th May till 26th May and 18th May to 24th during 2012 for different guava genotypes. On the other hand, in Egypt El-Sisy [7], found that, date of first flower opening during summer season varied from 13 May to 15 June during 2011 and 11 may to 12 June during 2012 when she studied 15 guava genotypes.

The data pertaining to fruit set percentage two weeks after setting and fruit set percentage two weeks before harvesting data showed significant differences among the genotypes, in the pooled mean 2016 and 2017 seasons of investigation and is depicted in Table (3).

The genotype G8 was found superior on over all genotypes, in terms of fruit set percentage two weeks after setting (92.44 %) and fruit set percentage two weeks before harvesting (90.20%) which was closely followed by the genotype G1 with the fruit set percentage two weeks after setting (90.20%) and fruit set percentage two weeks before harvesting (88.50%) whereas, lower fruit set percentage two weeks after setting (81.20%) and lower

Table 3: Data of flowering and setting of guava trees (Pooled mean 2016 and 2017 seasons).

Genotypes	Initial of flowering date	Full bloom date	End flowering date	Initial of fruit set date	Fruit set two weeks after setting (%)	Fruit set two weeks before harvesting (%)
1	2nd week of April	1st week of May	2nd week of June	1st week of June	90.22	88.50
2	2nd week of April	1st week of May	2nd week of June	1st week of June	89.60	85.50
3	2nd week of April	1st week of May	2nd week of June	1st week of June	89.10	84.70
4	2nd week of April	1st week of May	2nd week of June	1st week of June	88.00	84.50
5	2nd week of April	1st week of May	2nd week of June	1st week of June	90.00	87.30
6	2nd week of April	1st week of May	2nd week of June	1st week of June	89.55	85.20
7	2nd week of April	1st week of May	2nd week of June	1st week of June	87.00	84.10
8	2nd week of April	1st week of May	2nd week of June	1st week of June	92.44	90.20
9	2nd week of April	1st week of May	2nd week of June	1st week of June	90.00	87.00
10	2nd week of April	1st week of May	2nd week of June	1st week of June	84.90	83.22
11	2nd week of April	1st week of May	2nd week of June	1st week of June	81.20	78.20
12	2nd week of April	1st week of May	2nd week of June	1st week of June	84.30	81.50
13	2nd week of April	1st week of May	2nd week of June	1st week of June	86.50	83.30

Table 4: Data of yield of guava trees (Pooled mean 2016 and 2017 seasons).

Genotypes	Number of fruits/tree	Yield (kg/tree)
1	595.20 ab	53.67 b
2	590.00 ab	51.65 b
3	582.32 b	50.08 b
4	577.33 b	49.60 b
5	594.30 ab	53.56 b
6	587.42 ab	50.97 b
7	570.43 bc	48.67 b
8	602.00 a	68.03 a
9	590.34 ab	53.08 b
10	559.42 c	46.80 bc
11	532.66 d	41.79 bc
12	543.88 c	44.44 bc
13	570.00 bc	46.99 bc

Means in the same column followed by the same letter (s) are not significantly ($p \geq 0.05$) different.

fruit set percentage two weeks before harvesting (78.20%) were recorded in genotype G11 as shown Table (3). Our results validated the results of El-Sharkawy and Othman [6], reported that, the fruit set (%) ranged between (81.31 - 95.87) and between (82.51 - 97.70) in both seasons of study in five genotypes of guava. Also our results are in line with those obtained by Abou El-Khashab *et al*. [13], who reported that, the fruit set (%) ranged between (41.00-100), when they studied 11 genotypes of winter guava.

Yield Attributes: A significant variation in number of fruits (fruits/tree) and yield (kg/tree) was recorded among different guava genotypes Table (4).

The maximum number of fruits per tree was observed in the genotype G8 (602.00 fruits/tree) followed by G1 (595.20 fruits/tree) whereas, minimum number of fruits per plant was found in the genotype G11 (532.66 fruits/tree) as shown Table 4. The results are partially in line with those obtained by El-Sisy [7] who reported that, the fruit number/tree varied from 235.85 to 386.15 during 2011 and 215.85 to 383.85 during 2012 in 15 guava genotype. EL-Sharkawy and Othman [6] found that, the fruit number/tree ranged between 282 to 1335 and between 352 to 1896 in five guava genotypes in both seasons of his study.

The highest fruit yield per tree was observed in the genotype G8 (68.03 kg) followed by G1 (53.60 kg) whereas, lowest yield per tree found in the genotype G11 (41.79 kg) as shown Table (4). The results are partially in agreement with those obtained by El-Sisy [7] who found that, the yield of 15 guava genotypes ranged between (37.95 - 88.85 kg/tree) and from (34.91 - 89.99 kg/tree) in 2011 and 2012 respectively. EL-Sharkawy and Othman [6] reported that, the yield of five guava genotypes ranged between (46 - 137.7 kg/tree) and from (50.8 - 158.2 kg/tree) in both seasons of his study.

Physico-Chemical Characteristics of Guava Fruits: There was significant difference among the genotypes of guava for physico-chemical characteristics of fruits. The data on physico-chemical characteristics of fruits of different guava genotypes under study are presented in Tables (5 and 6).

The genotype G8 was superior to other genotypes in terms of fruit weight (113 g),fruit volume (99.22 cm^3), fruit length (8.3 cm), fruit diameter (7.3 cm), pulp thickness (2.33 cm), firmness (4.51 K g/cm^2), TSS (13.34 °Brix), acidity (0.29 %) and ascorbic acid (98.52 mg/100g) which was closely followed by the genotype G1 with the fruit weight (90.17 g),fruit volume (92.56 cm^3), fruit length (8.00 cm), fruit diameter (7.22 cm), pulp thickness (2.00 cm), seed weight to fruit weight ratio (1.90 %), firmness (4.22 Kg/cm^2), TSS (13.14 °Brix), acidity (0.33%)

Table 5: Data of physical characteristics of guava fruits (Pooled mean 2016 and 2017 seasons).

Genotypes	Fruit weight (g)	Fruit volume (ml)	Fruit length (cm)	Fruit diameter (cm)	Pulp thickness (cm)	Seed weight to fruit weight ratio	Firmness (Kg/cm^2)
1	90.17b	92.56b	8.00a	7.22a	2.00b	1.90c	4.22ab
2	87.55b	90.79b	7.73b	6.21c	1.89bc	2.30bc	3.55bc
3	86.00b	90.21b	7.33c	5.57d	1.82bc	2.67b	3.30bc
4	85.92b	90.00b	7.00d	5.50d	1.77bc	2.78b	3.10bc
5	90.12b	92.55b	8.00a	7.00b	2.00b	1.97c	4.00b
6	86.77b	90.44b	7.43c	6.00c	1.82bc	2.50b	3.52bc
7	85.32b	90.00b	6.97d	5.47d	1.72bc	2.89b	3.00c
8	113.00a	99.22a	8.30a	7.30a	2.33a	1.42d	4.51a
9	89.92b	92.16b	7.97ab	6.31c	2.00b	1.97c	3.98b
10	83.65b	88.23bc	6.78d	5.32d	1.68c	3.30ab	2.77cd
11	78.45c	84.34c	6.66e	5.00de	1.51c	3.77a	2.60d
12	81.71b	86.45c	6.71d	5.24d	1.64c	3.56ab	2.63cd
13	82.43b	88.46bc	6.97d	5.43d	1.72c	2.99b	3.00c

Means in the same column followed by the same letter(s) are not significantly ($p \geq 0.05$) different.

Table 5: Data of chemical characteristics of guava fruits (Pooled mean 2016 and 2017 seasons).

Genotypes	TSS (%)	Acidity (%)	Ascorbic acid (mg/100g)
1	13.14ab	0.33ab	94.55a
2	13.00b	0.36ab	93.54a
3	12.78c	0.40ab	91.55a
4	12.54d	0.44ab	90.36a
5	13.00b	0.34ab	94.00a
6	13.00b	0.36ab	93.22a
7	12.50d	0.44a	90.00a
8	13.34a	0.29b	98.52a
9	13.00b	0.34ab	93.77a
10	12.33d	0.47a	87.55ab
11	11.87f	0.49a	81.42ab
12	12.00e	0.47a	84.33ab
13	12.50d	0.45a	90.00a

Means in the same column followed by the same letter(s) are not significantly ($p \geq 0.05$) different.

and ascorbic acid (94.55 mg/100g) as given in the Tables (5 and 6). Whereas, the genotype G11had the lowest values of fruit weight (78.45 g), fruit volume (84.34 cm^3), fruit length (6.66 cm), fruit diameter (5.00 cm), pulp thickness (1.51 cm), firmness (2.60 Kg/cm^2), TSS (11.87 °Brix), acidity (0.49 %) and ascorbic acid (81.42 mg/100g) as shown Tables (5 and 6).

The highest values of seed weight to fruit weight ratio (3.77 %) were recorded in genotype 11. Whereas, the genotype G8 had the lowest values of seed weight to fruit weight ratio (1.42 %) as shown table 5. Our results are in agreement with those obtained Afifi [16] who reported that,, fruit weight ranged between 85.05 to 203.4 g, fruit length ranged between 5.48 to 9.49 cm, fruit diameter ranged between 5.43 to 7.53 cm, pulp thickness ranged between 0.90 to 1.49 cm, TSS ranged between 7.00 to 15.50%, acidity ranged between 0.20 to 0.57 % and ascorbic acid (VC) ranged between 58.18 to 195.4 mg/100g, when they studied 17 genotypes of guava. Similar results were also recorded by El-Sisy [7], who found that, the fruit firmness ranged between (1.43 to 9.03 Kg/cm^2), kumar *et al*., [17] reported that, the fruit volume ranged between 66.67 to 200.00 ml in 15 guava genotypes. Husameldin and Thuria, [18], who found that, the seed weight to fruit weight ratio ranged between (0.00 to 4.10 %) in 100 guava genotypes.

CONCLUSION

The evaluation study on elite type of guava genotypes has revealed that variability exists with regard to different growth characters, yield and quality attributes of fruits. From the present investigation, it is concluded that genotype G12 was superior to other genotypes in relation to different growth, yield and quality attributes of fruits as compared to rest of the genotypes and is recommended to be propagated and distributed to growers.

REFERENCES

1. Singh, G., 2005. Strategies for improved production in guava. In: Kishun R, Mishra AK, Singh G, Chandra R (Eds.), Proceeding of 1st International guava symposium. CISH, Lucknow, India, pp: 26-39.
2. Jaiswal, U. and V.S. Jaiswal, 2005. Psidium guajava. In: Litz RE (ed) Biotechnology of fruit and nut crops. CABI, Wallingford, pp: 394-401.
3. Pommer, C.V. and K.R.N. Murkami, 2009. Breeding guava (Psidium guajava L.). In: S.M. Jain and C.V. Pommer (eds) Breeding Plantation tree crop: Tropical species. Springer Sciences and Business media, LLC, pp: 83-120.

4. Ministry of agriculture and land reclamation, 2018. Cultivation and production of guava. Annual Report. https://www.agri2day.com.
5. El-Sisy, W. and A.M. Yousef, 2005. Evaluation of red guava cultivated in El-Mamoura Botincal garden for improvement and propagation program. J. Agric. Sci. Mansoura Univ., 30: 7907-7916.
6. El-Sharkawy, S.M.M. and I.M.S. Othman, 2009. Evaluation of some guava colons under water preventing condition at Qalyobia Governorate. Egypt. J. Appl. Agric. Res. (NRC), 2: 1-11.
7. El-Sisy, W., 2013. Evaluation of Some Genotypes of Guava Trees Grown under Alexandria Governorate Condition I. Vegetative Growth, Flowering and Fruit Quality. World Applied Sciences Journal, 28: 583-595.
8. Rokba, A.M., A.H. Ezzat and A.T. El-Wakeel, 1976. "Bassateen Edfina" a new selected Guava variety. Egypt J. Hort., 3(2): 209-219.
9. Allen, R.G., L.S. Pereira, D. Raes and M. Smith, 1998. Crop evapotranspiration-Guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper, No. 56, FAO, Rome.
10. Roose, M.L., D.A. Cole, D. Atkin and R.S. Kuper, 1986. Yield and tree size of four citrus cultivars on 21 rootstocks in California. J. Amer Soc. Hort. Sci., 114: 135-140.
11. Chou, G.J., 1966. A new method of measuring the leaf area of citrus trees. Acta. Hort. Sin., 5: 17-20.
12. Chawla, S., R. Devi and V. Jain, 2018. Changes in physicochemical characteristics of guava fruits due to chitosan and calcium chloride treatments during storage. Journal of Pharmacognosy and Phytochemistry, 7: 1035-1044.
13. Abou El-Khasab, A.M., M.A. El Iraqy and K.B. Essa, 2008. Evaluation of some selected “winter” guava strains for growth and yield in new reclaimed sandy soil. Egypt J. Appl. Agri. Res. (NRC), 1(2): 153-165.
14. Daljinder, S., 2013. Morphological and molecular characterization of germplasm and f1 hybrids. PAU Ludhiana. Ph.D Thesis. pp: 152.
15. Shiva, B., 2014. Morphological and molecular characterization of guava genotypes. PAU Ludhiana. Ph.D Thesis, pp: 123.
16. Afifi *et al*., 2019. Selection and evaluation of some guava strains under Behera governorate condition. Middle East Journal of Agriculture Research, 08(02): 469-481.
17. Kumar, J., R. Kumar, S. Tripathi and V.P. Singh, 2017. Physico-chemical and morphological evaluation of guava (*Psidium guajava* l.) genotypes under tarai conditions. HortFlora Research, 6(2): 97-101.
18. Husameldin, H.M. and S.P. Thuria, 2014. Physical screening in fruits of guava (*Psidium guajava* L.) genotypes. Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS), 5(2): 135-144.