

Morphological, Physico-chemical, and Pollen Grain Description of some Guava Varieties in Egypt

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AMONG the national objectives of the National Gene Bank and Genetic Resources (NGBGR) in Egypt are the collection, conservation, characterization, and evaluation of agricultural genetic resources. The present study investigates the physico-chemical characteristics, the morphological characterization and pollen grain fertility and sterility of some guava varieties grown in Egypt. Guava varieties used in the present work were Banaty, Mobakker, Fakous, Gize yellow, Montakhab Elkanater and Montakhab- Elsabaheya.

Twenty-seven morphological characteristics were studied to describe the tree, leaf, inflorescence, fruit, and seed. The morphological characterization showed wide range of differences among varieties. Characterization of tree shape resulted in four semielliptic varieties (Banaty, Mobakker, Fakous, and Montakhab- Elsabaheya), one obovate in Gize yellow and one was semicircular in Montakhab- Elkanater. The morphological characterization of leaf shape showed six different shapes roundish in Banaty, lanceolate in Mobakker, oval in Fakous, oblong in Gize yellow, oblong-lanceolate in Montakhab- Elkanater and obovate in Montakhab- Elsabaheya. Fruit shape studies showed five different shapes pyriform, globose, obovoid, ovoid and oblate. Shape of fruit apex demonstrated that three varieties were truncate (Banaty, Gize yellow and Montakhab- Elkanater), two were rounded (Mobakker and Fakous), and one was necked in Montakhab- Elsabaheya. Differences in fruit skin color among varieties revealed that one was light yellow, one was pale yellow, one was cream yellow, one was dark yellow and two were yellow. Other morphological studies are investigated and will be presented.

The physical and chemical analysis conducted included pH, titratable acidity, soluble solid content (SSC), total solid, ascorbic acid content and free sugar analysis (Fructose, Glucose and Sucrose). Results indicated that, total (SSC) were less than 8%. The pH and titratable acidity ranged from 3.96 in Fakous to 4.65 in Montakhab- Elsabaheya and 0.14% in Mobakker to 0.19% in Montakhab- Elkanater, respectively. The total solid varied from 100.1 g kg⁻¹fw in Montakhab- Elsabaheya to 134.2 g kg⁻¹fw in Fakous. The vitamin C content varied from 34.03 mg/100g in Gize yellow to 50.9 mg/100g in Montakhab- Elkanater. The free sugar analysis (Fructose, Glucose and Sucrose) ranged from 4.4 g/100g in Montakhab- Elsabaheya to 19.2

g/100g in Fakous, 4.3 g/100g in Fakous and Gize yellow to 6.8 g/100g in Banaty and 5.4 g/100g in Fakous to 14.8 g/100g in Montakhab-Elkanater, respectively.

Studies of pollen grain fertility percentage showed that, Fakous 97.86%, Banaty 97.7%, Gize yellow 96.82% and Montakhab-Elsabaheya 96.7% and 92.16% for Mobakker.

Key words: National Gene Bank and Genetic Resources - Egypt - Guava varieties - Physico-chemical characteristics - Morphological description - Pollen grain Fertility and Sterility.

Guava (*Psidium guajava* L.), which belongs to the Myrtaceae family, is a native of tropical America and is widespread throughout the tropical and subtropical areas (Chopda and Barrett, 2001). Guava is important in international trade and domestic economy of several countries in warmer climates (Menzel, 1985). Because of its easy cultivation under variable soils and climates, high nutritional value, and popular uses in such processed products like juice, preserves, and dairy or bakery items, guava is favorite of billions of people in the tropical and subtropical countries, but not so much in the temperate regions. Due to their astringent properties, mature guava fruits, leaves, roots, bark, and immature fruits, are used in local medicines to treat gastroenteritis, diarrhea, and dysentery (Morton, 1987 and Purseglove, 1968). Guava consumption has been reported to significantly reduce serum total cholesterol, triglycerides, and blood pressure with the opposite effect (an explicit increase) in high-density lipoprotein (HDL) or good cholesterol (Singh *et al.*, 1992). Guava is consumed fresh or made into processed products such as juice, nectar, puree, jam and jelly (Kashyap *et al.*, 2001). Guavas, mangoes and mangosteens are the most important tropical fruit crops grown in Egypt for their unique flavor and nutritional values. The area harvested (ha) in Egypt during 2005 year was 35000 ha. The average productivity per hectare during the same year 380,000 kg/ ha and the export Quantity of Primary Commodity (1000 tonnes) during the same year 10330 T (FAO, 2007).

The guava plant grows symmetrically dome-shaped with broad, spreading, low-branching canopy and a shallow-rooted small tree of 3 to 10 m in height, branching close to the ground and often heavily suckering from the base of the trunk. The green to reddish-brown and smooth bark on older branches and trunk peels off in thin flakes. The four-angled young twigs of guava are easily distinguished. The simple leaves of guava are opposite, 10 to 15 cm long, oval to oblong-elliptic, smooth, and light green in color. The perfect epigynous flowers 25 to 30 mm in diameter with four incurved white petals and a large tuft of white stamens with yellowish anthers, are borne solitary or in clusters of 2-3 in leaf axils on new growth from mature wood. Self-pollination is conspicuous (60% to 75%) since even isolated trees produce good crop; however, the distribution of cross-pollination by insects, is about 35% (Menzel, 1985). Based on the cultivar, guava fruit could be an ovoid, spherical or pyriform berry topped by calyx lobes. Generally, guava fruits measure 4 to 10 cm in diameter and weigh from 100 to

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450 g. Guava has a blend of sweet and acid flavors when fully ripe and characteristically a rather penetrating aroma (Yadava, 1994, 1996). From fruit set to maturity guava takes 150 days. Most of the famous cultivars contain numerous small, hard, yellowish-cream colored seeds which are imbedded in the soft pulp.

The guava fruit is an excellent source of vitamin C (Yadava, 1994). Guava fruit is abundant in dietary fiber (from 5 to 7%), vitamin A, vitamin C, pectin, phosphorus, calcium, and potassium (Yadava, 1994 and Yusof & Mohamed, 1987). Guava has a large amount of vitamin A and pectin, which is a soluble fiber. The edible skin is extremely rich in vitamin C, containing even more than an orange. Indigenous people of the rain forest region use guava leaves to treat various gastrointestinal ailments, especially diarrhea. Leaves from guava trees were recently discovered to contain flavonoids and antioxidants, which may explain their healing properties (Tiwari, 2000).

Guava is cultivated for mature fruits and immature fruits which are used fresh, and in local medicines (Morton, 1987). The genetic resources of guava in Egypt have not been characterized and evaluated systematically. The objectives of the present investigation were to study the physico-chemical characteristics, morphological characteristics of some guava varieties found in Egypt as well as their pollen grain viability.

Materials and Methods

Morphological characterization

Six Guava varieties grown at Horticulture Research Institute, Agricultural Research Centre (ARC), Ministry of Agricultural Research Centre at Giza, Egypt, including Banaty, Mobakker, Fakous, Gize yellow, Monakhab Elkanater and Montakhab- Elsabaheya were the source of materials used in this study at 3X5 m and flood irrigated. The present study was carried out during 2005 to 2006.

The morphological characteristics used to characterize and discriminate the 6 Guava varieties (all genotype had 15 years old) were based on those previously prescribed for Tropical fruit by the International Plant Genetic Resources Institute (IPGRI, 1980) taking into consideration all the precautions reported. In this respect, 12 quantitative and 15 qualitative morphological characteristics were selected for the present investigation. The study was performed using three trees for each variety; each tree was considered a replicate. Table 1 presents traits used for morphological characterization as well as their codes. In this respect, tree shape and growth habit were characterized in the natural state and immediately after harvest.

Thirty mature and fully developed leaves per tree were collected and characterized for leaf blade length, leaf blade width, ratio of leaf blade length/width, leaf shoot tip color, leaf shape, leaf margin, leaf apex shape, and leaf base shape. The study comprised also shoot length, shoot diameter and internode length. Data were recorded for flower number of color of open flower,

petal length and width. All observations on the fruit and its related parts were made at the optimum maturity stage. Fruit characteristics were observed on 10 variety typical fruits per each tree of the three replication trees. Data were documented for fruit weight, flesh thickness, fruit length, fruit width and shape. Records also included shape of fruit base and fruit apex, fruit skin color, and fruit skin surface. Fully developed seeds were extracted from 10 fully ripped fruits taken from each tree of the three replications. In this respect, average number of seeds per fruit, and seed shape.

TABLE 1. Code of morphological traits used in guava varieties characterization.

Code	Trait	Code	Trait
1. Quantitative Traits		2. Qualitative Traits	
Leaf blade length	LBL	Tree shape	TSh
Leaf blade width	LBW	Tree growth habit	TGH
Ratio of leaf blade length/width	RLW	Leaf shoot tip color	LShTC
Shoot length	ShL	Leaf shape	LSh
Shoot diameter	ShD	Leaf margin	LM
Internode length	InL	Leaf apex shape	LASH
Petal length	PL	Leaf base shape	LBSH
Petal width	PW	Fruit shape	FrSh
Fruit weight	FrWt	Shape of Fruit base	ShFrB
Flesh thickness	FTh	Shape of Fruit apex	ShFrA
Fruit length	FrL	Color of open flower	COFl
Fruit width	FrW	Fruit skin color	FrSkC
		Fruit skin surface	FrSkS
		Number of seeds per fruit	NSe/Fr
		Seed shape	SeSh

Physico-chemical characteristics

pH

The pH of the extract, obtained after mixing of 20 g sample in 100 ml of distilled water and filtering, was measured using a glass electrode laboratory pH meter (Model Cyberscan 510, EUTECH, Singapore).

Titrateable acidity

After determining pH, the solution was titrated with 0.1 M NaOH to pH 8.1, monitoring with an electrode and calculated as grams of citric acid per Kilogram fresh weight (fw).

Soluble solids content (SSC)

Soluble solids were measured from guava pulp samples with an Atago digital refractometer PAL-1 (Tokyo, Japan). Results are reported as %.

Total solid

Total solid was measured after heating in microwave (200 W) for 40 min, to a constant weight. Results were expressed as grams of total solids per kilogram fresh weight.

Determinations of vitamin C

Vitamin C was determined by HPLC. A volume of 50 g of each guava varieties was homogenized with 40 ml of an extraction solution (30 g 1-1 meta-phosphoric acid + 80 g 1-1 % acetic acid). The resulting mixture was filtered under suction and adjusted up to 100 ml with distilled water. Samples were filtered through a 0.45 μm membrane filter and duplicates of 20 μm for each extract were analysed by HPLC. Results are expressed as milligrams of ascorbic acid per 100 ml juice.

Separation of ascorbic acid was performed by HPLC using a Hypersil BDS C8 (5 μm) stainless steel column (250 mm x 4.6 mm) (Thermo Electron, United Kingdom). The solvent system used was an isocratic gradient of a solution 70% Buffer (0.85 % v/v H₂SO₄ in 17.5 mM KH₂PO₄, pH 1.8) and 30% Methanol. The flow rate was fixed at 1.5 ml/min. A UV- vis detector was set at 245 nm; chromatographic data and UV-vis spectra were collected, stored and integrated using a chromostar light software. The calibration curve was built with one concentration level an ascorbic acid standard solution (100mg ml⁻¹ in a solution 30 g 1-1 meta-phosphoric acid + 80 g 1-1 % acetic acid) (Sanchez-Moreno *et al.*, 2003).

Free sugar analysis

A portion of fresh fruit of guava was homogenized in 85% ethanol. The ethanol slurry was boiled for 120 min. Soluble sugar, F,G and S were performed by HPLC using a Hypersil APS2 (5 μm) stainless steel column (250 mm x 4.6 mm) (Thermo Electron, United Kingdom). The solvent system used was an isocratic gradient of a solution 80% Acetonitrile (ACN) and 20% water (H₂O). The flow rate was fixed at 0.5 ml/min. ELSD (Evaporative Light Scattering detector) was set at 30°C nebolization, 90°C evaporation and 1.6 SLM gas. Chromatographic data was collected, stored and integrated using chromostar light software. The calibration curve was built with one concentration level (Mollá *et al.*, 1994).

Statistical analysis

All data obtained was subjected to analysis of variances according to Snedecor and Cochran (1980) and mean were differentiated using Duncan's multiple range test (Duncan, 1955).

Pollen grain viability

Ten randomly selected whole flowers per each of the three trees of the studied varieties were collected at appropriate stage (full bloom) for studying pollen grain viability, and immediately fixed in a 3:1 alcohol/ acetic acid solution for 24 hours. Then they were washed with distilled water several times before

being stored in 70 % ethanol. Squash preparations of pollen mother cells (PMC's) were made in aceto carmine as described by Fayed *et al.* (1984). About 20 slides were prepared from 10 randomly selected flowers for each genotype. The prepared slides were used to determine the following cytogenetical characters.

The percentages of viable and aborted pollen were estimated by testing their stain ability in aceto carmine staining. Round and Darkly stained pollen grains were considered to be viable and functional while non-viable and grains were the shrivelad or lightly stained ones described by Fayed (1990).

The differences in the types of pollen grain viability between the studied genotypes, were statistically tested using Duncan's multiple range test to measure the degree of significance for these differences.

Result and Discussion

Morphological characterization

Quantitative characteristics

Figure 1 presents quantitative characteristics of leaf blade length (LBL), leaf blade width (LBW) and ratio of leaf blade length/width (RLW) of 6 Guava varieties under the present investigation. Results showed that Mobakker variety exhibited the highest LBL of 14.41cm followed by Banaty (12.52 cm) variety. The lowest leaf blade length was presented by Monakhab Elkanater (10.75 cm), Fakous (11.43 cm) and Montakhab- Elsabaheya (11.43 cm) varieties. The lowest LBW values were obtained by Montakhab- Elsabaheya (4.2 cm) variety and Banaty variety exhibited the highest leaf blade width of 7.1cm. The uppermost ratio of leaf blade length/width was showed by variety Mobakker (2.62) followed by Montakhab- Elsabaheya (2.1) and Gize yellow (2.08) varieties. The lowest RLW was characterized in Banaty (1.76) (Fig. 1).

The Monakhab Elkanater, Gize yellow and Montakhab- Elsabaheya varieties showed the highest value of shoot length (ShL) of 19.0, 18.66 and 17.83 cm, respectively. The lowest ones were exhibited by the Banaty (15.0 cm) and Mobakker (15.5 cm) varieties. Whereas the Fakous variety illustrated intermediate values. There was no significant difference between all the 6 varieties, in internode length (InL). Banaty variety showed the greatest shoot diameter (ShD) of 0.45cm. However, there was no significant difference between the Mobakker, Fakous, Gize yellow, Monakhab Elkanater and Montakhab- Elsabaheya, varieties, in this respect (Fig. 2).

■ Leaf blade length (cm) ■ Leaf blade width (cm) □ Ratio leaf blade L/W

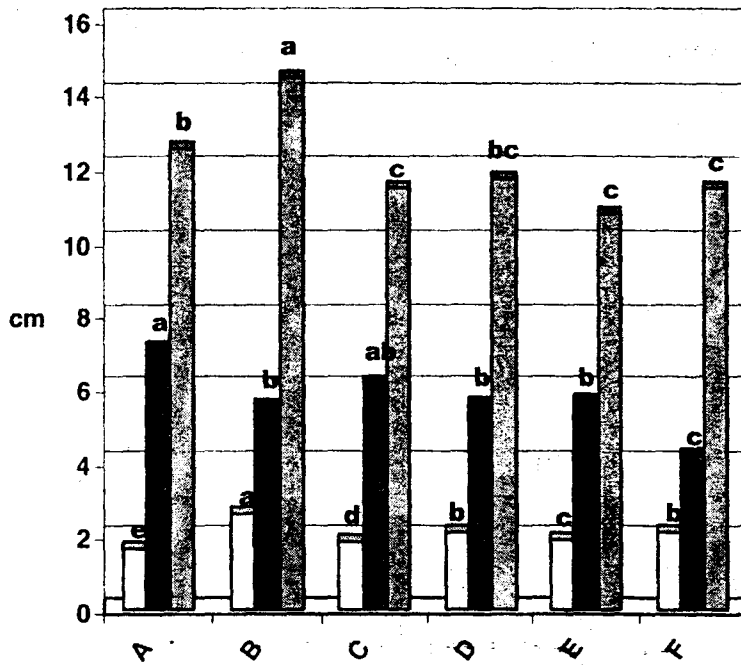


Fig. 1. Quantitative characteristics of leaf blade length, leaf blade width and ratio of leaf blade length/width of 6 Guava varieties.

Means followed by the same letter within the same column color are not significantly different (0.05; LSD test). Characteristics were described of leaf blade length, leaf blade width and ratio of leaf blade L/W for Guava by the International Plant Genetic Resources Institute (1980).

A: Banaty, B: Mobakker, C: Fakous, D: Gize yellow, E: Monakhab Elkanater, F: Montakhab baheya.

■ Shoot length (cm) ■ Internode length (cm) □ Shoot diameter

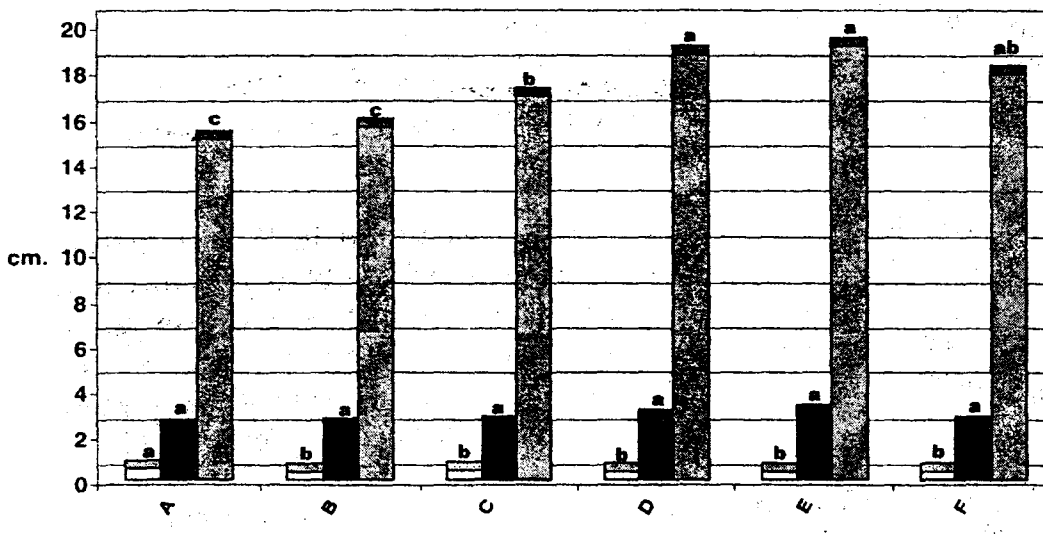


Fig. 2. Quantitative characteristics of shoot length, internode length and shoot diameter of 6 Guava varieties.

Means followed by the same letter within the same column color are not significantly different (0.05; LSD test). Characteristics were described of shoot length, internode length and shoot diameter for Guava by the International Plant Genetic Resources Institute (1980).

A: Banaty, B: Mobakker, C: Fakous, D: Gize yellow, E: Monakhab Elkanater, F: Montakhab baheya.

The petal length (PL) was different among the varieties where the Banaty (2.05 cm) variety presented the highest measurements. On the contrary, the Mobakker variety had the lowest PL of 1.68 cm. The rest of the varieties showed intermediate values of petal length. The varieties Monakhab Elkanater, Banaty, Fakous and Mobakker presented the highest petal width (PW) of 1.25, 1.23, 1.23 and 1.22 cm, respectively. On the other hand, the respective lowest PW values of 1.13 and 1.1 cm were showed by the varieties Gize yellow and Montakhab-Elsabaheya (Fig. 3).

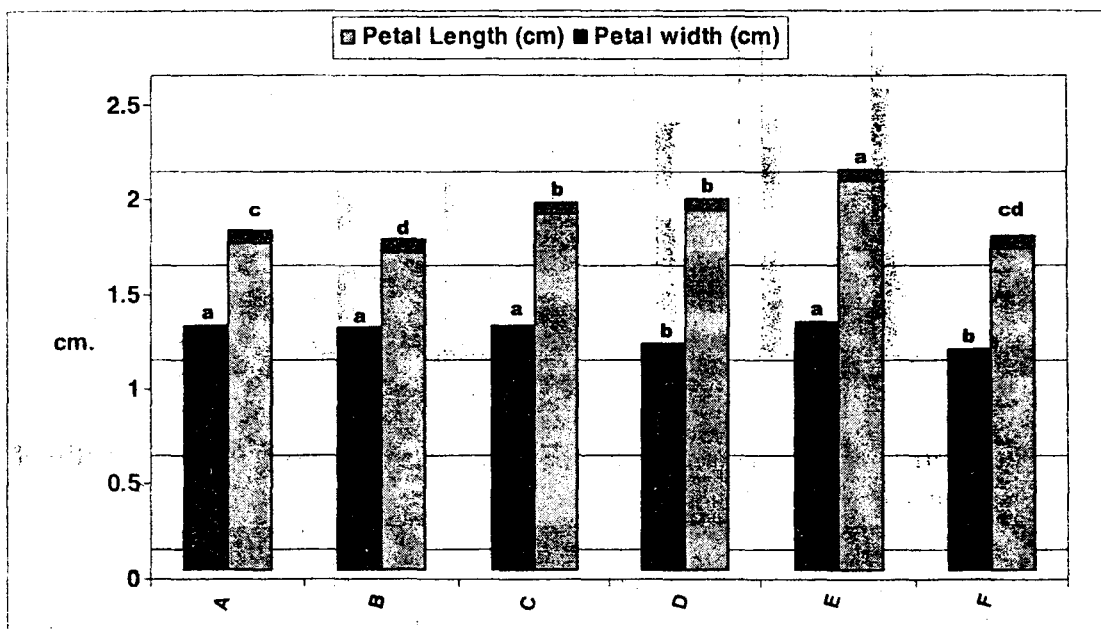


Fig. 3. Quantitative characteristics of petal length and petal width of 6 Guava varieties.

Means followed by the same letter within the same column color are not significantly different ($P \leq 0.05$; LSD test). Characteristics were described of petal length and petal width for Guava by the International Plant Genetic Resources Institute (1980).

A: Banaty, B: Mobakker, C: Fakous, D: Gize yellow, E: Monakhab Elkanater, F: Montakhab Elsabaheya.

The quantitative characteristic of fruit is demonstrated in Fig. 4. Fakous variety showed the highest significant fruit weight (FrWt) (130.0 g) followed by Banaty (123.3 g) variety. On the other hand, variety Mobakker and Gize yellow had the lowest FrWt of 60.0 and 70.0 g, respectively. The rest of the varieties gave intermediate fruit weights. Although variety Banaty exhibited the greatest flesh thickness (FTh) (16 cm), it had no significant differences as compared with the Monakhab Elkanater (15.0 cm) variety. On the contrary, the Mobakker displayed the lowest FTh (10.0 cm). However, no significant differences were detected as compared with Fakous and Gize yellow varieties (Fig. 4).

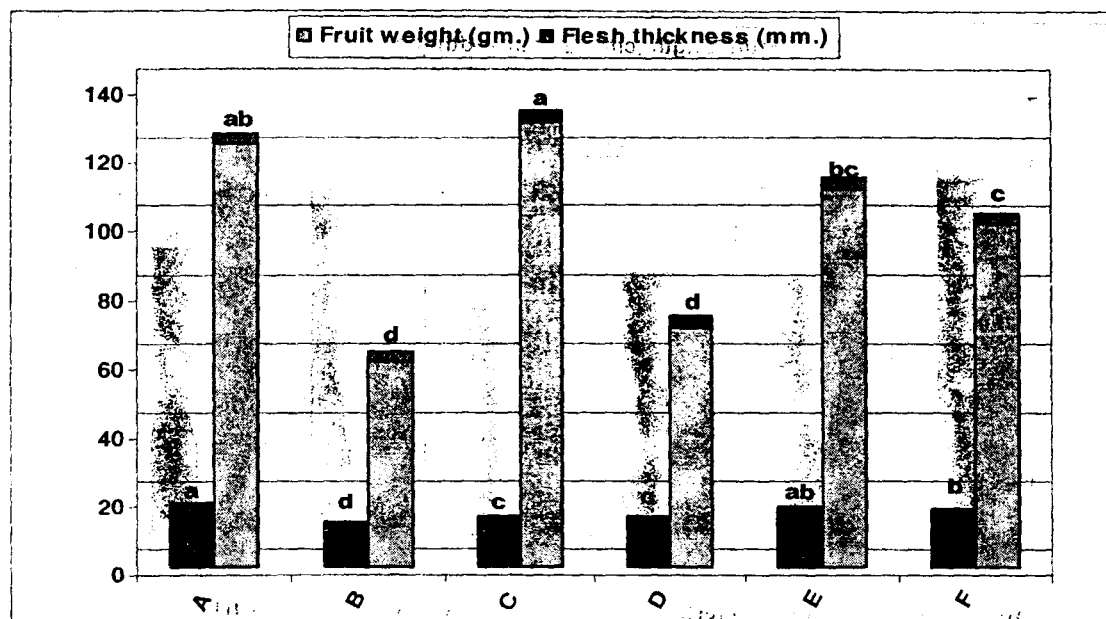


Fig. 4. Quantitative characteristics of fruit weight and flesh thickness of 6 Guava varieties.

Means followed by the same letter within the same column color are not significantly different ($P \leq 0.05$; LSD test). Characteristics were described of shoot length, internode length and shoot diameter for Guava by the International Plant Genetic Resources Institute (1980).

A: Banaty, B: Mobakker, C: Fakous, D: Gize yellow, E: Monakhab Elkanater, F: Montakhab Elsabaheya.

Monakhab Elkanater exhibited the most significant fruit length (FrL) (6.5 cm) followed by the Banaty and Fakous varieties (6.0 cm). The least FrL was demonstrated by the variety Gize yellow (5.0 cm). However, no significant differences were obtained as compared with the varieties Mobakker (5.5), Gize yellow (5.0) and Montakhab- Elsabaheya (5.167). Figure 5 also shows the greatest fruit width (FrW) was observed in variety Banaty (5.5 cm) followed by the variety Monakhab Elkanater (5.0 cm). Conversely, the varieties Mobakker, Fakous and Gize yellow revealed the lowest (4.0, 4.0 and 3.5 cm, respectively.) FrW.

Qualitative characteristics

Table 2 presents the qualitative traits of 6 Guava varieties under the study. Banaty, Mobakker, Fakous, and Montakhab- Elsabaheya varieties demonstrated semielliptic tree shape (TSh), whereas Gize yellow had obovate and Monakhab Elkanater had semicircular. The degrees of tree growth habit (TGH) included spreading or drooping growth habit. One of the varieties under the study demonstrated drooping growth habit. The tree growth habit of the varieties Banaty, Mobakker, Fakous, Gize yellow, and Monakhab Elkanater was spreading.

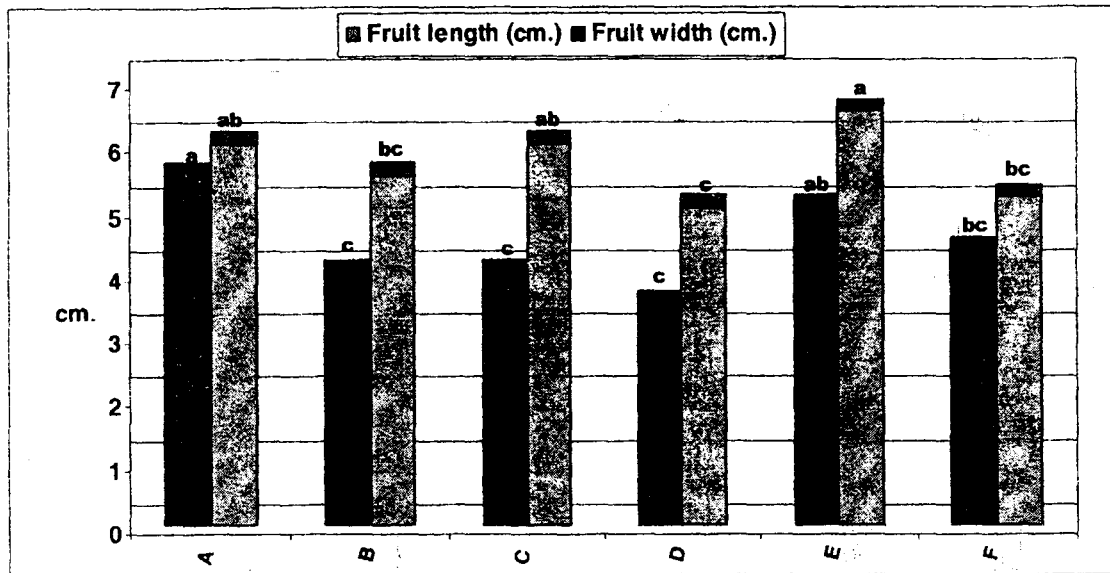


Fig. 5. Quantitative characteristics of fruit length and fruit width of 6 Guava varieties.

Means followed by the same letter within the same column color are not significantly different ($P \leq 0.05$; LSD test). Characteristics were described of shoot length, internode length and shoot diameter for Guava by the International Plant Genetic Resources Institute (1980).

A: Banaty, B: Mobakker, C: Fakous, D: Gize yellow, E: Monakhab Elkanater, F: Montakhab Elsabaheya.

TABLE 2. Qualitative characteristics of 6 Guava varieties.

Variety	Banaty	Mobakker	Fakous	Gize yellow	Monakhab Elkanater	Montakhab-Elsabaheya
TSh	semielliptic	semielliptic	semielliptic	obovate	semicircular	semielliptic
TGH	spreading	spreading	spreading	spreading	spreading	drooping
LShTC	purple	green	green	green	green	green
LSh	roundish	lanceolate	oval	oblong	oblong-lanceolate	obovate
LM	undulate	undulate	undulate	entire	entire	undulate
LASh	obtuse	intermediate	obtuse	obtuse	intermediate	obtuse
LBSH	obtuse	obtuse	obtuse	obtuse	obtuse	obtuse
COFI	white	white	white	cream	white	white
FrSh	globose	obovoid	ovoid	oblate	pyriform	pyriform
ShFrB	rounded	short necked	truncate	rounded	depressed	rounded
ShFrA	truncate	rounded	rounded	truncate	truncate	necked
FrSkC	pale yellow	cream yellow	light yellow	yellow	dark yellow	yellow
FrSkS	smooth	smooth	wrinkled	smooth	Smooth with grooved	intermediate
SeSh	seedless	ovate	oblate	ellipsoid	broadly ovate	broadly ovate
NSe/Fr	seedless	159	49	173	218	136

Characteristics were described for citrus by the International Plant Genetic Resources Institute (1999).

TSh: Tree shape, TGH: Tree growth habit, LShTC: Leaf shoot tip color, Leaf shape: LSh, Leaf margin: LM, Leaf apex shape: LASh, Leaf base shape: LBSH, Color of open flower: COFI, Fruit shape: FrSh, Shape of Fruit base: ShFrB, Shape of Fruit apex: ShFrA, Fruit skin color: FrSkC, Fruit skin surface: FrSkS, Seed shape: SeSh, Number of seeds per fruit: NSe/Fr.

All varieties showed green color of leaf shoot tip (LShTC) except for the Banaty that showed purple color (Table 2). The study of Leaf shape (LSh) included roundish, lanceolate, oval, oblong, oblong-lanceolate and obovate. All varieties exhibited different LSh (Table 2). The varieties Banaty, Mobakker, Fakous, and Montakhab- Elsabaheya demonstrated undulate Leaf margin (LM) whereas the rest of the varieties showed entire leaf margin. The categories under which leaf apex shape (LASH) of the different varieties was evaluated obtuse or intermediate leaf apex. The varieties Banaty, Fakous, Gize yellow, and Montakhab- Elsabaheya proved obtuse LASH, whereas Mobakker and Monakhab Elkanater varieties confirmed intermediate leaf apex shape. All varieties showed obtuse of leaf base shape (LBSH):

Table 2 illustrates the fruit qualitative characteristics of the 6 Guava varieties under the study. In this regard, the study of fruit shape (FrSh) included globose, obovoid, ovoid, oblate, and pyriform. Regarding shape of shape of fruit base (ShFrB), the varieties Banaty, Gize yellow and Montakhab- Elsabaheya showed rounded shape of fruit base, whereas Mobakker demonstrated short necked, Fakous displayed truncate and Monakhab Elkanater demonstrated depressed ShFrB (Table 2). Regarding shape of fruit apex (ShFrA), the variety Montakhab- Elsabaheya showed necked shape of fruit apex, whereas Banaty, Gize yellow and Monakhab Elkanater demonstrated truncate ShFrA (Table 2). The remaining of the varieties displayed rounded shape of fruit apex. All varieties showed white in Color of open flower (COFI) except for the Gize yellow that showed cream. The fruit skin color (FrSkC) included light yellow, cream yellow, yellow, pale yellow, and dark yellow. The variety Banaty had pale yellow skin color while that of the Gize yellow and Montakhab- Elsabaheya varieties was yellow (Table 2). The fruit skin color of Mobakker was cream yellow. The rest of the varieties exhibited light yellow and other was dark yellow fruit skin color. The fruit skin surface relative to stigma (FrSkS) was studied against Guava varieties under the study (Table 2). Fakous variety exhibited wrinkled of FrSkS, while Monakhab Elkanater had smooth with grooved and Montakhab- Elsabaheya had intermediate of fruit skin surface. The rest of the varieties had smooth of fruit skin surface.

The seed shape (SeSh) included ovate, oblate, ellipsoid, and broadly ovate. Only the variety Banaty had seedless. The variety Mobakker had ovate SeSh, while Fakous was oblate and Gize yellow was ellipsoid SeSh. The rest of the varieties exhibited broadly ovate SeSh. The average number of seeds per fruit (NSE/Fr) was generally high in most of the varieties tested (Table 2). The highest counted number of seeds per fruit (218) was evident in the varieties Montakhab Elkanater. The varieties Mobakker, Fakous, Gize yellow, and Montakhab- Elsabaheya showed 159- 49- 173- 136 seeds per fruit, respectively. Only the Banaty variety presented seedless.

Physico-chemical characteristics

Table 3 shows the some physical and physicochemical parameters of guava accessions. pH in the varieties studied ranged between 3.96 in the Montakhab-Elsabaheya to ~ 4.46 in other varieties. Titratable acidity in the varieties studied, values were all relatively low, ranged between 0.14% in Mobakker to 0.19% in Monakhab- Elkanater. There were no significant differences found in contain of soluble solids content (SSC) in all varieties. The total solid content varied from 100.1 to 134.2 g kg⁻¹fw. Ascorbic acid was determined by HPLC. Ascorbic acid content in the guava accessions evaluated varied from 34.3 to ~ 44.7mg/100g. In this work, the highest Ascorbic acid content (~44.7 mg/100g) was found in the Banaty, Mobakker, Fakous, Monakhab- Elkanater and Montakhab- Elsabaheya. There were no significant differences found between these five different kinds of varieties. The lowest Ascorbic acid content (34.3 mg/100g) was found in Gize yellow.

TABLE 3. Some physical and physicochemical characteristics of Guava varieties

Variety	pH	SSC °Brix	Acidity %	Vit.C mg /100 g	Total Solid g kg ⁻¹ fw	Free sugar g/100g		
						F	G	S
Banaty	4.52a	7.36a	0.17ab	46.72ab	104.9c	7.7e	6.8a	10.3b
Mobakker	4.46a	7.16a	0.14b	44.72ab	133.1a	12.2b	4.9d	7.9c
Fakous	3.96b	7.50a	0.16ab	50.36a	134.2a	19.2a	4.3e	5.4f
Gize yellow	4.49a	7.83a	0.16ab	34.03b	115.9b	10.7c	4.3e	7.0e
Monakhab- Elkanater	4.54a	7.8a	0.19a	50.9a	125.9ab	8.6d	6.7b	14.8a
Montakhab- Elsabaheya	4.65a	7.73a	0.15ab	48.37a	100.1c	4.4f	6.3c	7.3d

Values have the same letter (s) in the same column are not significantly different at 5% level using Duncan's Multiple Range Test.

F: fructose, G: glucose, S: sucrose

Free sugars (fructose, glucose and sucrose) were determined by HPLC. Fructose, glucose and sucrose content in the guava accessions evaluated varied from 4.4 to 19.2 gm/100gm, 4.3 to 6.8 gm/100gm and 5.4 to 14.8 g/100g, respectively.

Vitamin C being the major contributor to the antioxidant activity of Guava fruits, whereas sweetness has high correlation with SSC, pH, and sugars (fructose, and glucose) (Fernandez *et al.*, 2004).

In conclusion, the HPLC methods presented allow a fast, quantitative and reproducible determination of important bioactive compounds in Guava fruits.

Pollen grain viability

As Table 4 showed, the parental genotypes exhibited varied frequencies of pollen sterility and fertility. The highest pollen abortion was found in the

genotypes, Mobakker, Monakhab- Elkanater and Montakhab- Elsabaheya, respectively. Fig. 6 demonstrates the different shapes of pollen grain fertility and sterility in Guava. Moreover, the data of test Duncan's showed that there were significant differences in mean frequency of pollen sterility and fertility between the genotypes in almost cases (Table 4). However mean of pollen grain fertility was higher than 92%.

Lower frequency of chromosomal aberration indicated a higher level of pollen fertility.

TABLE 4. Frequency of pollen fertility and sterility in Guava.

Variety	No. of pollen grains examined	No. of viable pollen grains	Mean % of pollen sterility	Mean % of pollen fertility
Banaty	1519	1484	2.30 c	97.70 a
Mobakker	1620	1493	7.84 a	92.16 c
Fakous	1865	1825	2.14 c	97.86 a
Gize yellow	1795	1738	3.18 c	96.82 a
Montakhab-Elkanater	2103	1976	6.04 b	93.96 b
Montakhab-Elsabaheya	1604	1551	3.30 c	96.70 a

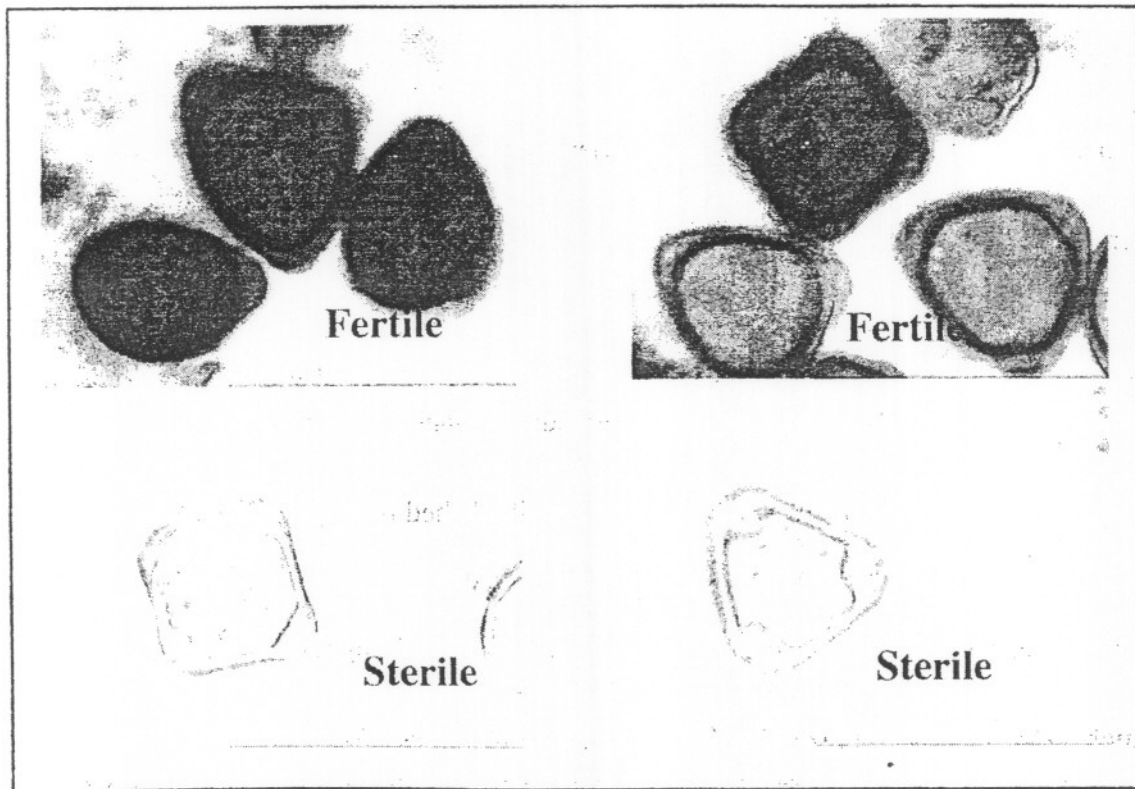


Fig. 6. Different shapes of pollen grain fertility and sterility in Guava

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التوصيف الظاهري والصفات الفزيوكيميائية وخصوبة حبوب اللقاح لأصناف الجوافة في مصر

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تتضمن المهام القومية للبنك القومي للجينات والموارد الوراثية بجمهورية مصر
العربية عمليات جمع وحفظ وتوصيف وتقييم الموارد الوراثية الزراعية. وتهدف
الدراسة الحالية إلى التوصيف الظاهري ودراسة الصفات الفزيوكيميائية وإختبار
حيوية حبوب اللقاح لعدد 6 أصناف من الجوافة .

وكانت الأصناف تحت الدراسة هي بناتي، مبكر، فاقوس، جيزي أصفر،
منتخب القناطر، منتخب الصباحية. وقد تم دراسة عدد 27 صفة مورفولوجية على
الشجرة، الورقة، النورة، الثمرة، البذرة. وقد أظهرت دراسة الصفات الظاهرية
تباين واضح بين الأصناف تحت الدراسة. وقد أوضحت دراسة شكل الشجرة على
وجود أربعة أصناف تتميز بالشكل ellipsoid ، صنف يتميز بالشكل obovate ،
وصنف يتميز بالشكل semicircular.

وقد أوضحت نتائج دراسة شكل الورقة (Leaf shape) وجود 6 أشكال
مختلفة وهي oblong- ، oblong، oval ، lanceolate ، roundish ،
obovate ، lanceolate. أظهرت دراسة شكل الثمرة وجود 5 أشكال مختلفة
وهي oblate ، ovoid ، obovoid ، globose ، pyriform. وقد إختلفت
الأصناف أيضا في شكل قمة الثمرة حيث تميزت ثلاثة أصناف بصفة القمة
truncate، وأثنان بالصفة rounded ، وصنف واحد تميز بشكل قمة necked .
أوضحت دراسة لون قشرة الثمرة وجود صنف واحد ذو لون أصفر فاتح، صنف
واحد يتميز باللون pale yellow ، وصنف باللون الأصفر الكريمي، وصنف
باللون الأصفر الغامق، وصنفين باللون الأصفر.

التحاليل الفزيائية والكيميائية تحت الدراسة تضمنت درجة الـ pH، الحموضة
الكلية، نسبة المواد الصلبة الذائبة، total solid ، تقدير المحتوى من حمض
الأسكوربيك، تحليل free sugar ويتضمن تقدير كل من: الفركتوز ، الجلوكوز ،
السكروز. وأظهرت النتائج أن نسبة المواد الصلبة الذائبة أقل من 8% . وكل من
درجة الـ pH و الحموضة الكلية تتراوح ما بين 3,96 إلى 4,65 و 0,14% إلى
0,29% على التوالي. المواد الصلبة الكلية تتراوح ما بين 100,2 جم لكل 1 كيلو
جرام وزن طازج إلى 134,2 جم لكل 1 كيلو جرام وزن طازج . محتوى فيتامين
C تراوح ما بين 34,03 مللجم/100جم إلى 50,9 مللجم/100جم. نتائج تحليل
كل من الفركتوز ، الجلوكوز ، السكروز تراوحت ما بين 4,4 جم/100جم إلى
19,2 جم/100جم ، 4,3 جم/100جم إلى 6,8 جم/100جم، 5,4 جم/100جم
إلى 14,8 جم/100جم على التوالي.

كما أوضحت دراسة خصوبة حبوب اللقاح أن نسبة الخصوبة في صنف
فاقوس 97,86%، بناتي 97,7%، جيزي أصفر 96,82%، منتخب الصباحية
96,7%، مبكر 92,16%.