A Comparative Study on Some Pomegranate Cultivars Grown Under the Ecological Conditions of Souhag Governorate

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Abstract: The present investigation was carried out at the experimental farm of Horticulture Research Station, Shandaweel, Souhag Governorate, Egypt, during the two years of 2008 & 2009 to find out the performance of six pomegranate cultivars including Tahreer, Badr, Wardy, Nab El-Gamal, Araby and Manfalouty. Significant varietals' difference in the studied growth parameters were observed among pomegranate cultivars. Manfalouty cv performed the highest No. of leaves & shoots/twig and the widest trunk circumference as well as the highest No. of hermaphrodite flowers/ twig. However, Badr cv produced the highest No. of total & male flowers/ twig as well as fruit set (%) but it had the least No. of hermaphrodite flowers/ twig and sex ratio. Tahreer cv produced the highest No. of twigs/tree and the longest ones and the maximum tree height and canopy circumference. Generally, male flowers started to emerge as well as ended before hermaphrodite flowers, where, Badr was the earliest in this respect. Regards to hermaphrodite flowers and fruit set dates, Badr followed by Araby and Wardy were the earliest; however, Manfalouty was the latest. Manfalouty was the most productive cultivar followed by Nab El-Gamal. Contrarily, Wardy produced the lowest yield in both seasons. The minimum cracked fruits percentage (9.43 & 11.15) was recorded in Badr cultivar. However, this recently parameter recorded the maximum in Araby (15.11 & 15.49). Tahreer cv tended to produce higher No. of sun - burnt fruits/tree, while, Wardy cv recorded the lowest ones. Araby cv recorded the lowest marketable fruits percentage (72.44 & 71.37%); however, Wardy trees exceed other cultivars in marketable fruits (%) that it recorded 82.41 & 84.10%, respectively, in both seasons. Most of the studied fruit qualities were differed between two seasons (this may be due to changes in environmental conditions), where they were higher in the 2nd one. Manfalouty showed its superiority with respect to the studied fruit quality parameters, while Wardy was the worst. Moreover, the two cvs took the same trend in non-edible part (rind & capillary membranes) fresh weight, as well as aril and seed weight/fruit. Manfalouty cultivar was the superior for most of fruit juice components except for non-reducing sugars (%). The aril chemical analysis showed significant differences in all measured elements. ***Generally,*** under the same conditions of the present study we may recommend Manfalouty cultivar due to high productivity and its superiority in fruit quality parameters and juice components. Wardy trees exceed other cultivars in marketable fruits (%). Badr followed by Araby and Wardy as early cropping cultivars.

Keywords: Pomegranate - Evaluation – Morphological - Flowering - Yield - Fruit physical and chemical quality - Juice chemical analysis

INTRODUCTION

Pomegranate (*Punica granatum L.*) is an ancient favorite table fruit of tropical and sub-tropical regions of the world. This fruit is mentioned in the Koran and Bible and is often associated with fertility (Elfalleh *et al.,* 2008 and Ahmet *et al.,* 2009). This ancient fruit has been emerged as a commercially important fruit in the recent times. Perhaps the aspect that contributed the most to the increased demand of pomegranates all over the world is the renewed interest in its health promoting effects (Mustafa *et al.,* 2008).Traditional usage of pomegranate was already practiced in many human cultures. Recent modern scientific work strengthens the status of pomegranate fruit as an important medicinal fruit that contains valuable medically active compounds (Ibrahim, 2010). Potentially active phytochemicals found in pomegranates include sterols and terpenoids in the seeds, bark and leaves, alkaloids in the bark and leaves, fatty acids and triglycerides in seed oil (Waleed *et al.,* 2011), simple gallyol derivatives in the leaves, organic acids in the juice, flavones in the rind, fruit, bark and leaves and anthocyanins in the juice and rind (Hamidreza *et al.,* 2008 and Shanshan *et al.,* 2007). The level of these compounds in the pomegranate tree may change during the development of the tree, during fruit maturation, under different environmental and cultivation conditions and among pomegranate cultivars (Elinor *et al.,* 2009). Pomegranates are widely grown in many tropical and subtropical countries, especially in the moderate climate of the Mediterranean region. This tree species is well adapted to marginal lands and arid soils. (Sheets *et al.,* 2004; Muradoglu *et al.,* 2006 and Ozguven *et al.,* 2009). The versatile adaptability, hardy, nature, low maintenance cost, steady but high yields, better keeping quality, fine table and therapeutic values and possibilities to throw the plant into rest period when irrigation potential is generally low, indicate the avenues for increasing the area of pomegranate in new reclaimed areas. Egypt is among the countries of the temperate region of the northern hemisphere and relatively close to equator which have arid or semi- arid conditions that suitable for pomegranate production. All of these point to the fact that pomegranate is an endemic tree of Egypt. So it has been widely cultivated in Egypt long time ago. The total cultivated area of pomegranate reached 8300 feddan with total fruit production of 51299 metric tons (according to the latest statistics of the Ministry of Agriculture, 2009). This area is mainly concentrated in Upper Egypt Governorates (about 66%). According to Mars and Maraschino (1999) pomegranate

culture is still faced with many problems and methods must be developed for cultivar identification and improvement, and genetic resource management (Zhang *et al.*, 2008; Kumar & Khosla 2009; Sarkhosh *et al.*, 2009 and Rao & Subramanyam, 2010).

Large fruit, thin and red colored skin, and soft abundant juicy, no fruit cracking, high and regularly bearing, early, medium and late seasonal ripening, sweet, sour and sour-sweet tasted juice are considered among the desired fruit and plant characteristics for pomegranate evaluation effort (Muradoglu *et al.*, 2006).

Pomegranates have not received much attention from researchers in Egypt. Area under cultivation, rate of expansion, varietals diversity, yield per tree and product quality are considerable. Some of the Egyptian commercial cultivars were previously evaluated for their fruit characteristics and chemical components under Alexandria (Ibrahim *et al.*, 1985), Assiut (El-Sese, 1988 and El-Kassas *et al.*, 1998), El- Behaira (Abou- El-Khashab *et al.*, 2005) as well as (Gowda *et al.*, 2009) under Beni – Sweif Governorate conditions.

Due to the increasing interest in pomegranate consumption and the knowledge that the nutritional composition varies according to the cultivar, this work aimed to investigate the performance of six pomegranate cultivars including Araby, Badr, Manfalouty, Nab El-Gamal, Tahreer and Wardy vegetative growth, flowering, yield and physical & chemical quality characters of fruits for their suitability to Souhag Governorate (Upper Egypt) conditions.

MATERIAL AND METHODS

The present investigation was carries out at the experimental farm of Horticulture Research Station, Shandaweel, Souhag Governorate, Egypt, during the two years of 2008& 2009 to find out suitable cultivars of pomegranate on the basis of yield and quality attributes.

Six cultivars of pomegranate (Tahreer, Badr, Wardy Nab El-Gamal; Araby and Manfalouty) were taken to conduct the experiment. The selected trees were of the same age (6 years), with approximately the same vigor and planted at 6x5 meters apart in sand - clay soil under flood irrigation system. In each season, 9 pomegranate trees of each investigated cultivar (3 replicates x 3 trees/each) were selected and grown under the same environmental conditions and cultural practices.

The chemical analyses of the soil are presented in Table (1), The Average monthly temperature (°C) and relative humidity (%) at Souhag Governorate in both investigated years is presented in Figures (1, 2, 3&4).

Table (1): Chemical analyses of the experimental soil.

PH	EC (Mill mhos/ Cm)	Saturation Extract (Mill equivalent/C)						
		Ca^{++}	Mg^{++}	HCO_3^-	$CO_3^{=}$	K^+	Na^+	Cl^-
		30-60 cm depth						
7.6	0.73	3.1	3.4	3.0	-	0.14	2.5	3
		60-120 cm depth						
7.7	0.69	2.5	1.6	3.5	-	0.17	3.3	4
Texture		**Available nutrient concentration (ppm)**						
		N	**P**	**K**	**Fe**	**Mn**	**Zn**	**Cu**
		30-60 cm depth						
Sand - clay		96.1	12.1	359	7.7	3.9	2.22	0.27
		60-120 cm depth						
		54.8	7.7	141	14.0	3.2	1.90	0.62

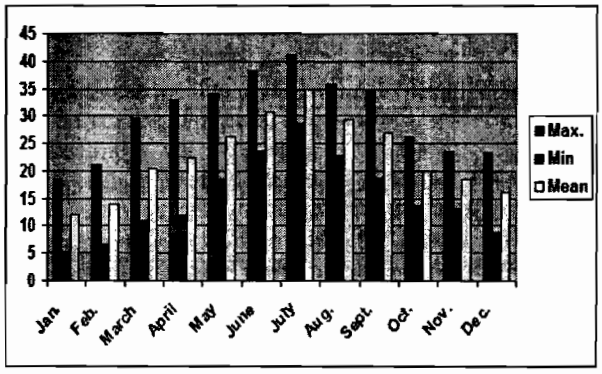

Fig. (1)

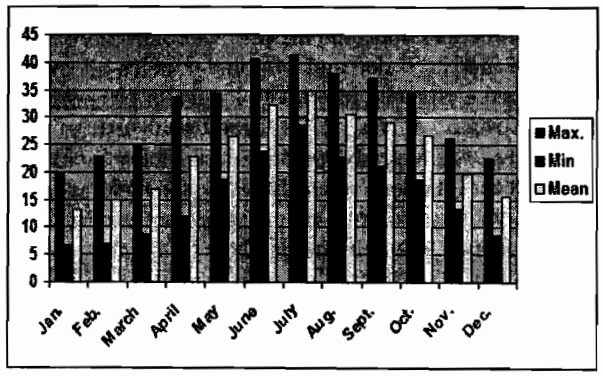

Fig. (2)

Figures (1&2): Average monthly temperature (°C) at Souhag Governorate, Egypt during 2008& 2009 seasons.

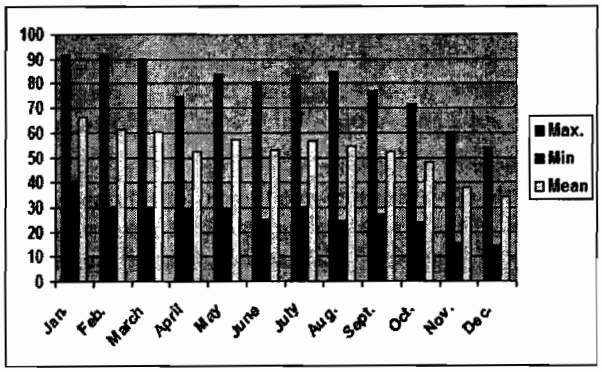

Fig. (3)

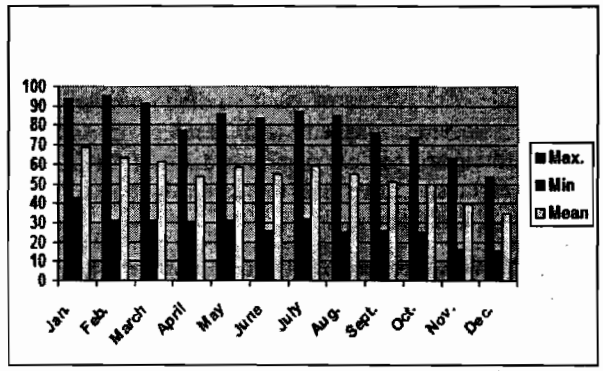

Fig. (4)

Figures (3&4): Average monthly relative humidity (%) at Souhag Governorate, Egypt during 2008& 2009 seasons.

The studied cultivars were investigated for the followings:

Morphological characters:

Shoot growth parameters:

In each season of study, No. of twigs/tree were recorded and 8 twigs of each replicate tree (2/each direction) were selected at random and tagged for measuring twig length & diameter (cm); no. of leaves and internodes / twig; leaf area (cm)3 using area meter CI-203 as well as diameter (cm) of sprouted shoots.

Tree form:

Circumference of tree trunk (cm) was measured at uniform height (1m) using calibrated circumference tape during dormant season. Tree height (m.) was also recorded in dormant season with clinometers and canopy width measured across widest point. In addition, tree head shape was classified to pointed or fountain like shape.

Flowering characteristics:

No. of flowers and fruit set (%):

At the time of growth (mid-March), the previously selected twigs were measured for no. of total male and hermaphrodite flowers/ twig and sex ratio was calculated relative to total number of hermaphrodite (perfect) flowers/twig. The number of hermaphrodite flowers which succeeded to set fruits was also counted and labeled and fruit set (%) was calculated.

Dates of flowering, fruit set and maturity:

The beginning and end of vegetative growth and flowering (male & hermaphrodite) dates were recorded. At the end of blooming period, the date of beginning of fruit set was determined. Date of fruit maturity of each tested cultivar was also recorded.

Yield and fruit quality characteristics:

Harvesting and yield:

Pomegranate fruits were harvested from Sept.– Oct. (depending on cultivar). Total yield / tree was calculated as yield weight kg/ tree and total fruit number/tree was recorded. No. of cracked & sunburned fruits/tree were counted and their percentages were calculated. Marketable fruits/tree (%) was calculated.

Fruit quality characteristics:

A sample of fruits (n = 10) of each studied cultivar was randomly selected for determining the following physical and chemical properties:

Fruit physical properties:

Fruit weight (gm); length & diameter (cm) and fruit shape index was calculated (length/width). Fruit volume (cm^3) was measured. Fruit rind touch was classified as rough or smooth or medium and rind color was classified from yellow to deep red; while fruit neck as clear or non-existent or medium and fruit ribs as clear or rounded or medium.

Then, selected fruits were peeled by hand in the laboratory, rind thickness (cm) was measured and number of rooms / fruit was counted, then, separately, their rind and capillary membranes (non-edible part) and weighted, thus calculating the aril (edible part) weight/fruit by the difference between total fruit and non-edible part weights. Then aril weight /fruit weight ratio was calculated. No. of arils/ fruit was counted. The seeds of each cultivar were then mixed together to carry out the detailed study. Seed weight /fruit (gm) and juice volume (cm^3) were measured and rind (%) of total fruit weight was calculated. The seeds were classified according to the hardness of their woody portion to soft or intermediate or hard. Colors of aril and juice taste were also classified.

Fruit juice chemical composition:

Total soluble solids content (TSS %) in fruit juice was measured using an Atago N-20 refractometer at 20°C. Neutralizing the acids in a 10 ml juice sample with 0.1 NaOH N and phenolphthalein as an indicator then expressed it as gram citric acid / 100 ml juice as described in (A .O .A .C., 1985) then, T.S.S./acid ratio was calculated. Total sugars and reducing & non-reducing sugars percentages were determined according to the method described by Dubois *et al.*, (1956); the amount of the estimated sugars in each sample was calculated in term of glucose. Vitamin (c) content (mg) Ascorbic acid / 100 ml juice by (A .O .A .C., 1985). Total anthocyanin (mg /100 ml) content in fruit juice and rind were measured as described by Hsia *et al.*,

(1965). Tannins content was determined in fruit juice by the method described by Winton and Winton (1945).

Aril mineral composition:

A sample of 10 fruits of each studied cultivar was randomly selected, washed and peeled by hand separately, their aril (edible part), air dried at 70 C° till constant weight and grounded for determination of the following nutrient elements:

- **Nitrogen:** Was determined by the modified Micro-Kjeldahl method as outlined by (Pregl, 1945).

- **Phosphorous:** Was estimated by the method of Murphy & Riley (1962).

- **Potassium:** Was determined by flame-photometer according to Chapman and Pratt (1961).

-Ca, Zn , Mn and Cu were Spectrophoto-Meterically determined using Atomic Absorption (Model, Spectronic 21D) as described by (Jackson, 1973). The concentrations of N, P, K and Ca were expressed as percent, while those of Zn, Mn and Cu were expressed as parts per million.

Statistical analysis:

The results obtained were submitted to Analysis of Variances according to Snedecor and Cochran (1980) and means were differentiated using Duncan's Multiple Range Test (Duncan, 1955). Whereas capital and small letters were used for differentiating the values of specific and interaction effects of the investigated factors, respectively.

RESULTS AND DISCUSSIOINS

Morphological characters:

Shoot growth parameters:

It can be noticed from Table (2) and Fig. (5) that, there was a noticeable significant varietals difference in the studied growth parameters among pomegranate cultivars. In this respect, No. of twigs/tree and their Av. length and diameter varied from 11.33 (Badr) in 1st season & 12.33 (Nab El-Gamal) in 2nd season; 119.00 & 133.33 cm in Manfalouty and 1.97 & 2.10 cm in Badr, to reach 16.67 & 18.67; 159.67 185.00 cm in Tahreer and 3.10 & 3.23cm in Nab El-Gamal, this was true in both seasons, respectively. The longest shoots was recorded in Nab El-Gamal trees (31.33 & 33.00 cm) however, Tahreer & Badr had the shortest ones (15.67 19.00 & 15.00 17.33 cm). With regard to the variations in No. of shoots/twig and Av. shoot diameter, Badr cultivar exceeded the others (24.00 & 25.67) in No. of shoots/twig and Araby in shoot diameter (0.50 7& 0.63 cm). Manfalouty cv recorded the maximum No. of leaves / twig (550.00 & 586.67), whereas, Araby cv took the other way around (550.00 &586.67). No. of internodes/ twig and leaf area ranged from (8.57, 8.39) & (108.33, 125.00cm3) in Wardy cv to (7.64, 6.76) in Badr & (40.67, 48.67) in Tahreer, respectively, in both seasons. Some of these results disagreed with Khalil *et al.* (1985) and Gowda *et al.*, (2009); however, they are in agreement with Abou-El-khashab *et al.*, (2005) on some pomegranate cultivars. This wide variability that exists in shoot growth parameters in different pomegranate cultivars under Egyptian different environmental conditions may be attributed to the differences in region and geographic area and orchard management (Nirmal & Bist, 2005) on pomegranate (Awad, 2002 and Abou – Taleb *et al.*, 2011) on pecan.

Tree form:

Table (3) represents tree dimensions throughout the duration of the trial, showing that there was a noticeable significant varietals' difference among the studied pomegranate cultivars. The best tree performance expressed as height and canopy circumference was noticed in Tahreer (2.83, 3.10 & 9.03, 9.50 m) in both seasons and Manfalouty cv (2.80 & 8.83 m) in 2nd season. The least tree height was recorded in Wardy cv (2.37 & 2.60 m) and canopy circumference in Badr cv (7.30 & 7.67 m) in both seasons, respectively. Moreover, tree trunk circumference ranged from (35.00 & 39.00 m) in Tahreer cv to reach (62.33 & 65.67 m) in Manfalouty cv. As for head shape, Tahreer, Wardy and Nab El-Gamal have pointed shape while the others are fountain like shape.

Such wide differences in the performance of pomegranate cultivars could be because of the genotype × environment interaction. The varietal evaluation studies in different parts of the world imply that a variety found suitable in one agro-climatic region may not do equally well in another. Thus there is a need to locate region specific varieties suitable for various soil and climatic regions. Moreover, for the local market, appropriate varieties need to be identified based on local consumer preferences (Diao, 2004; Chen *et al.*, 2005; Gowda *et al.*, 2009 and Jalikop, 2010).

Flowering characteristics:

No. of flowers and fruit set (%):

Table (4) & Figure (6) reveal significant differences among the studied pomegranate cultivars with respect to their flowering characteristics which had been previously identified as: male and hermaphrodite flowers. The maximum total No. of flowers (92.00 & 94.67) and male flowers/ twig (79.00 & 81.33) were recorded in Badr trees, however, it had the lowest No. of hermaphrodite flowers (13.00 & 13.33) and sex ratio (14.13 &14.08). Moreover, Manfalouty followed by Araby produced higher No. of hermaphrodite flowers/ twig in both seasons. The least records of male (45.33 & 50.33) and total flowers / twig (63.33 & 68.00) was observed on Tahreer trees however, it showed the highest sex ratio (25.26 & 25.99).

With regard to the variations in fruit set (%) it varied from (26.00 & 26.00) in Manfalouty to reach (about fold) in Badr (60.00 & 52.00) in both seasons, respectively.

Under agricultural production conditions, male: hermaphrodite flower ratios in pomegranate can impact crop productivity and yield. Male flowers drop and generally fail to set; to visualize pollen fruits develop exclusively from bisexual flowers. A positive growth in the style, pistils was dissected from flowers and relation was found between the percentages of bisexual flowers (Hazel, 2011). The appearance of bisexual and functionally male flowers on an individual plant can

Table (2): Vegetative growth parameters of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons.

Cultivar	No. of twigs/tree		Av. twig length (cm)		Av. twig diameter (cm)		No. of leaves/ twig		Leaf area $(cm)^2$		No. of internodes/ twig		No. of shoots/ twig		Av. shoot length (cm)		Av. shoot diameter (cm)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Tahreer	16.67 A	18.67 A	159.67 A	185.00 B	2.60 B	2.70 B	446.67 B	466.67 B	8.30 A	6.70 D	40.67 D	48.67 E	21.33 AB	25.00 A	15.67 D	19.00 C	0.43 BC	0.50 B
Badr	11.33 D	13.33 C	161.67 A	192.33 A	1.97 C	2.10 C	410.00 C	410.00 C	7.64 B	6.76 D	80.33 B	81.33 BC	24.00 A	25.67 A	15.00 D	17.33 C	0.47 AB	0.60 A
Wardy	13.33 BC	14.67 B	159.67 A	187.00 B	3.03 A	3.27 A	373.33 D	390.00 C	8.57 A	8.39 A	108.33 A	125.00 A	16.33 C	18.67 BC	25.33 BC	27.67 B	0.40 CD	0.47 B
Nab El-Gamal	12.33 CD	12.33 D	140.67 B	155.67 C	3.10 A	3.23 A	463.33 B	486.67 B	7.66 B	7.86 B	77.33 B	77.33 C	20.67 B	22.00 AB	31.33 A	33.00 A	0.37 D	0.47 B
Araby	11.67 D	12.67 CD	124.00 C	148.00 D	2.20 C	2.37 BC	323.33 E	353.33 D	8.45 A	7.29 C	63.33 C	67.00 D	16.00 C	16.33 C	23.00 C	27.00 B	0.50 A	0.63 A
Manfalouty	14.33 B	15.33 B	119.00 D	133.33 E	2.10 C	2.43 BC	550.00 A	586.67 A	8.28 A	7.65 BC	82.00 B	84.67 B	23.67 A	25.67 A	26.00 B	29.67 B	0.47 AB	0.60 A

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

Table (3): Tree dimensions of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons.

Cultivar	Tree height (m)		Circumference of tree trunk (cm)		Canopy circumference (m)		Head shape
	2008	2009	2008	2009	2008	2009	
Tahreer	2.83 A	3.10 A	35.00 E	39.00 E	9.03 A	9.50 A	Pointed
Badr	2.50 C	2.73 D	40.33 D	45.33 D	7.30 C	7.67 E	Fountain like shape
Wardy	2.37 C	2.60 E	47.67 C	52.67 C	8.83 A	9.10 B	Pointed
Nab El-Gamal	2.47 C	2.72 D	58.67 B	62.00 B	8.97 A	9.07 BC	Pointed
Araby	2.65 B	2.83 C	43.67 D	45.67 D	8.37 B	8.57 D	Fountain like shape
Manfalouty	2.80 A	3.00 B	62.33 A	65.67 A	8.83 A	8.77 CD	Fountain like shape

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

Table (4): Flowering characteristics and fruit set (%) of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons.

Cultivar	Total male flowers/ twig		Total hermaphrodite flowers/ twig		Total flowers/ twig		Sex ratio		Fruit set (%)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Tahreer	45.33 E	50.33 E	16.00 C	17.67 C	63.33 C	68.00 D	25.26 A	25.99 A	35.00 B	30.00 C
Badr	79.00 A	81.33 A	13.00 D	13.33 D	92.00 A	94.67 A	14.13 C	14.08 D	60.00 A	52.00 A
Wardy	62.67 C	72.00 B	19.00 AB	20.33 B	81.67 B	93.00 A	23.46 B	21.86 C	38.00 B	27.00 D
Nab El-Gamal	52.00 D	54.33 D	17.00 BC	17.67 C	69.00 C	72.00 C	24.64 AB	24.54 AB	54.00 A	48.00 B
Araby	61.67 C	63.67 C	20.00 A	20.67 B	81.67 B	84.33 B	24.69 AB	24.50 AB	32.00 BC	27.00 D
Manfalouty	69.67 B	74.67 B	20.67 A	22.00 A	90.33 A	96.67 A	22.88 B	22.76 BC	26.00 C	26.00 D

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

Figure (5): Leaf characteristics of the studied pomegranate cultivars

provide ecological and evolutionary advantages. Changes in sex allocation are considered a strategy to enhance fitness over the lifetime of the plant Meena, *et al.,* (2009) and can allow control of male and female function by modifying the emphasis of ovules or pollen development. With andromonoecy, the ratio of bisexual and male flowers can change with season, plant age, position within the plant, and environment (Miller & Diggle, 2007 and Holland *et al.,* (2009). Martinez *et al.,* (2000) found that the proportion of the two flower types can exhibit genotypic differences. The percentage of flowers that are male in pomegranate can be significant and more than 60% to 70% depending on variety and season (Chaudhari & Desai, 1993 and Mars, 2000). Furthermore, having high numbers of male flowers can be a way to spread genes, because pollen spread is more efficient with more male flowers (Herlihy & Eckert, 2002; Oukabli, *et al.,* 2004 and Dhinesh, 2010).

Dates of flowering, fruit set and maturity:

Table (5) shows noticeable variations between pomegranate cultivars and even between two seasons in dates of flowering, fruit set and maturity which may be due to changes in environmental conditions. Generally, it can be noted that, male flowers started to emerge as well as ended before hermaphrodite flowers, where, Badr was the earliest in this respect. Regards to hermaphrodite flowers and fruit set dates, Badr followed by Araby and Wardy were the earliest (except for the ending date of hermaphrodite flowers in 2nd season); however, Manfalouty was the latest in this concern. El-Sese (1988) and Gowda *et al.* (2009) found that Araby cultivar was earlier than Manfalouty and Nab El-Gamal under Assiut and Beni – Sweif Governorate conditions, respectively. Moreover, fruits of Wardy and Araby cvs matured earlier than the other cultivars whereas, Manfalouty followed by Nab El-Gamal was took the other way around.

Flowering in pomegranate is characterized as having both hermaphroditic (bisexual) flowers and functionally male flowers on the same plant, a condition referred to as andromonoecy (Hazel, 2011). The hermaphroditic flowers have well-formed female (stigma, style, ovary) and male (filaments and anthers). Because the hermaphroditic flowers are the type that set fruit, they are commonly referred to as "female" flowers. The male flowers produce well-developed male parts. Thus, their role is more accurately depicted as functionally male flowers but rather have degenerated female parts. Male flowers typically drop and fail to set fruit (Holland *et al.,* 2009). Manipulating the relative ratio of flower types to environmental conditions can be very advantageous. As a result of the high costs associated with female expression, repression of this flower type under poor environmental conditions could be a means to conserve limited resources at a time when maturation of a high fruit/seed yield is not possible. (Herlihy & Eckert, 2002 and Tanurdzic & Banks, 2004).

Yield and fruit quality characteristics:

Harvesting and yield:

Data in Table (6) declared that, Manfalouty trees produced the highest yield as Kg /tree (32.91 & 51.66) followed by Nab El-Gamal (30.35 & 46.55). Contrarily, Wardy pomegranate cultivar produced the lowest yield (20.36 & 18.56) in both seasons, respectively. No. of fruits /tree varied from (75.00 & 71.00) in Araby to reach (112.33 & 104.00) in Nab El-Gamal. It is worthy to mention that, the minimum cracked fruits percentage (9.43 &11.15) was recorded in Badr cultivar. However, Araby cv produced the maximum cracked fruits percentages (15.11 & 15.49), in both seasons, respectively. Wardy cv recorded the lowest sun-burnt fruits (%) as it recorded 6.55 % in the 1st season, the differences were insignificant in 2nd season. Manfalouty surpassed other cultivars in sun-burnt fruits (%) especially in 1st season. From the economical point of view, Araby cv recorded the lowest marketable fruits percentage (72.44 & 71.37 %), respectively, in both seasons; however, Wardy trees exceed other cultivars in marketable fruits (%) that it recorded (82.41 & 84.10%).

In relation to fruit cracking in pomegranate, as a serious problem in pomegranate production, many opinions have been propounded. It is believed that a complex of environmental, practical and genetical factors is effective in the genesis of this disorder (El-Khawaga, 2007). It was found that weakness of epidermis, formation of sclereid clusters and air cavity in ground tissue causes cracking in pomegranate (Gharesheikhbayat, 2006). This may occur due to varietal characters, orchard soil management, in-appropriate levels of water at maturity stage, light, temperature and micro-nutrient deficiency. It may also be caused as a result of hormonal effect. Cracked fruit skin and seed had lower level of auxin. The gibberellins, cytokines and abscisic acid (ABA) levels were higher in skin, seed and aril of cracked fruit (Yilmaz & Ozguven 2004 and Rakesh *et al.,* 2010). It is generally found in apricot, litchi, cherry, apple, pomegranate, citrus, and nectarine. The average loss of fruit cracking ranges from 50-85 %.

Fruit peel browning (sunburn) in Manfalouty pomegranate is a serious disorder and can reach from 10-20 % in Assuit region (El-Masry, 1995). Intense exposure of the fruit to sunlight can cause sunburn damage which render the fruit unmarketable. Pomegranates are especially sensitive to sun because they are terminal-bearing plants (El-Masry, 1995; Yazýcý *et al.,* 2005 and Yazýcý & Kaynak, 2006).

Fruit quality characteristics:

Fruit physical properties:

The results in Tables (7 & 8) and Fig. (7) Indicated that, pomegranate differed in their fruit physical properties according to cultivar. The data in Table, 7 declared that, generally, most of the studied fruit qualities were differed between two seasons, where they were higher in the 2nd one; this may be due to environmental changes during both studied seasons. The mean fruit length was from 7.43cm (Badr) and 7.70 (Wardy) to 8.67 & 9.53 cm (Manfalouty).The mean fruit width was between 7.37 & 7.60 cm (Wardy) and 8.67 & 10.10 cm (Manfalouty). Therefore, the majority of cultivars were rounded shape fruits. However, Manfalouty cv had the biggest fruit size and Wardy had the smallest. The differences in shape index between cvs didn't reach level of significance (1st season) but

slightly differed in the 2nd one. No. of rooms ranged between 5 to 6 rooms in all cvs. The mean skin thickness of fruit rind was between 0.31; 0.39 & 0.34; 0.37 cm (Badr & Wardy) and 0.52 & 0.69cm (Manfalouty). It may be interested to note that, Manfalouty showed its superiority with respect to the studied fruit quality parameters, while Wardy was the worst. In this respect, the Av. fruit weight for two years ranged from 210.73 & 232.87g. (Wardy) to 429.67 & 582.67g. (Manfalouty). Moreover, the abovementioned two cvs took the same trend in non-edible part (rind & capillary membranes) fresh weight, as well as aril & seed weight/fruit. Regards to aril /fruit weight ratio, the differences were insignificant in 1st season, while Badr observed the highest values (0.56) and Araby was the lowest (0.42) in the 2nd season. Juice volume was determined between 84.00 & 86.67 cm^3 (Wardy) and 127.33 & 271.67 cm^3 (Manfalouty). Also, the maximum No. of arils/fruit (edible-part) was recorded in Nab-El-Gamal (565.67) in the 1st season and Manfalouty (770.00) in the 2nd one, however, Wardy recorded the lowest values (312.67 & 361.67) in both seasons, respectively.

Seed was soft in Tahreer & Badr, hard in Nab-El-Gamal and intermediate in the remaining three cultivars (Table, 8). Fruit rind touch varied from rough (Nab-El-Gamal & Araby), smooth (Tahreer), very smooth (Manfalouty) and medium (Badr & Wardy). Fruit ribs were clear in Tahreer & Manfalouty, un-clear in Wardy that had rounded shape while, the ribs was medium in the other cvs. Fruit neck is considered a specific character that can be used to identify pomegranate cvs, where it was very clear in Nab-El-Gamal, Manfalouty & Araby cvs. All cultivars under study had rounded shape. Rind color varied between yellow-green to red – pink. Aril color was dark red to purple red (Manfalouty), very light pink (Araby) and light pink in the others. Juice of Tahreer, Badr & Araby fruits had sweet taste but the remaining cultivars their fruit juice was sweet with desirable acidity.

Good fruit quality includes fruit size and shape, rind and seed color. There is large variability among cultivars for these traits that may be greatly influenced by agro-environment and harvesting date. Our results were previously confirmed by other researchers (Kitren & Louise 2004; Abou-El-Khashab *et al.*, 2005; Nirmal & Bist, 2005; Lu *et al.*, 2006; Elfalleh *et al.*, 2008; Gowda *et al.*, 2009 and Rashid *et al.*, 2009). Attractive aril color is one of the most important sensory attributes and, perhaps, nutritional advantages of pomegranate.

Fruit juice chemical composition:

The pattern of fruit chemical composition is a very important consideration in selecting a pomegranate cultivar. It is interesting to note from Table (9) that, Manfalouty cultivar was the superior for most of fruit juice components except for non-reducing sugars (%) where the differences didn't reach level of significant, however, the differences in reducing sugars were slightly differed between studied cvs. As for total sugars (%) were found from 13.35, 13.17 & 13.55, 13.51 % (Nab El-Gamal & Tahreer) to 15.67 & 14.98 (Araby). The values of T.S.S. & acidity were observed in their lowest levels (12.37, 12.30 & 0.84, 0.80) in Araby fruits, however, the lowest T.S.S. / acidity ratio was recorded in Nab El-Gamal fruit juice (9.98 & 10.00), in both trial seasons.

Fruits juice of Manfalouty cv were the richest in percentage of either T.S.S. (14.73 & 15.27) or acidity (1.44 & 1.46), however their ratio was the best in Wardy (14.78 & 15.44). Vitamin (c) ranged from 13.19 & 13.16 mg (Wardy) to 23.21 & 24.07 mg (Manfalouty). The lowest tannins records were found in Nab El-Gamal (2.19 & 2.18 %). Total rind anthocyanin (%) in both rind and juice of Manfalouty fruits surpassed other cultivars as it recorded (0.29, 0.25 & 0.64 & 0.61); this was true in both seasons of study.

A significant variation among some pomegranate cultivars in respect of fruit physico-chemical properties were previously found under Alexandria (Ibrahim *et al.*, 1985), Assiut (El- Sese, 1988 and El-Kassas *et al.*, 1998), El- Behaira (Abou- El- Khashab *et al.*, 2005) as well as (Gowda *et al.*, 2009) under Beni – Sweif Governorate conditions. They found that pomegranate differed in their fruit chemical properties among cultivars under different Egyptian environmental conditions. Pomegranate fruit is widely used in the food and process industries due to its excellent nutritional and health value and as a raw material for the manufacture of secondary products (Linus *et al.*, 2007). The recent popularity and high price of pomegranate juice have led to concerns regarding the authenticity of some of the products in the marketplace. The available literature on pomegranate juice composition is very thin (Zarei et al., 2010). There is, thus, a need for additional information regarding the typical composition of commercial pomegranate juice (Elinor *et al.*, 2009). Anthocyanins are a member of phenolics compounds that contributes to the red, blue or purple color of many fruits including pomegranate juice and they are well known for their antioxidant activity (Moyer *et al.*, 2002). The anthocyanin profile is highly consistent across varieties and geographic origins (Maria *et al.*, 1995; Muradoglu *et al.*, 2006; Hamidreza *et al.*, 2008; Varasteh *et al.*, 2009 and Ali *et al.*, 2010). It is well-known that the sugar/acid ratio in many fruits is a primary driver of flavour quality (Mustafa *et al.*, 2008). It has been reported that tannins play an important role in human health and are implicate with numerous biological properties. Condensed tannins are also known as proanthocyanidins which are polymeric flavonoid molecules that found in a range of higher plant species. Vitamin C is a highly effective antioxidant, acting to lessen oxidative stress, a substrate for ascorbate peroxidase, as well as an enzyme cofactor for the biosynthesis of many important biochemicals (Linus *et al.*, 2007). Vitamin C is also connected with the health of bones, teeth, hormones, collagen, and blood vessels. It plays an important role in absorbing other important substances, such as iron, calcium, and folacin, and it may help cataracts, cancer, and heart diseases (Disabled World, 2007).

Aril mineral composition:

One of the most important factors from industrial point of view is the juice content of the aril. The chemical analysis results of the pomegranate cultivars

investigated are shown in (Table, 10). Significant differences were detected in all measured elements. The concentration of N varied from 0.97 & 0.98 % in Araby to reach 1.35 & 1.26 % in Tahreer. The highest content of K (1.53 & 1.69 %), Ca (1.51 & 1.57 ppm) and Mn (1.79 & 1.97 ppm) was recorded in Manfalouty cv; however, it had the lowest P content (1.03 & 1.03%). A variation in terms of Ca content was observed among the pomegranate cultivars (1.32 & 1.26 - 1.51 & 1.57 ppm). The highest and the lowest Zn content were detected in Nab El-Gamal and Tahreer, respectively. Juice Cu content was between 1.47 & 1.61 ppm (Wardy) and 2.01 & 2.12 ppm in Badr.

Vitamins and minerals are essential nutrients your body needs in order to function properly. Vitamins and minerals boost our immune system and promote normal growth and development in the human body. At least seven minerals are required to support biochemical processes. Calcium (for muscle, heart and digestive system health, builds bone, neutralizes acidity, supports synthesis and function of blood cells). Magnesium is required for processing ATP and related reactions (health builds bone, increases alkalinity). Phosphorus is a component of bones and energy processing and many other functions. Potassium is a systemic electrolyte and is essential in co regulating ATP with sodium (Disabled World (2007). Pomegranate juice is well known for its health beneficial compound (Elinor *et al.*, 2009).The composition of pomegranate juice depends on cultivar type, growing region, climate, maturity, cultural practice, storage and processing factors (Reddy, 2005; El-Nemr *et al.*, 2006; Seyed & Majid, 2007 and Melgarejo *et al., 2008*).

Table (5) : Dates of vegetative and male & hermaphrodite flowers growth, fruit set and harvesting of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons

Cultivar	Male flowers				Hermaphrodite flowers				Fruit set		Fruit maturity	
	2008		2009		2008		2009		2008	2009	2008	2009
	Start	End	Start	End	Start	End	Start	End				
Tahreer	3 / 4	15/4	22/3	1 / 4	10/4	27/5	28/3	28/5	17/4	13/4	22/9	8/9
Badr	28/3	17/4	20/3	28/3	2/4	23/5	22/3	27/5	15/4	10/4	15/9	2/9
Wardy	27/3	14/4	16/3	22/3	10/4	25/5	25/3	15/5	20/4	12/4	10/8	15/8
Nab El-Gamal	5/4	17/4	20/3	28/3	15/4	28/5	28/3	4/6	27/4	18/4	25/9	12/9
Araby	5/4	17/4	20/3	27/3	8/4	24/5	25/3	15/5	17/4	11/4	20/8	25/8
Manfalouty	5/4	15/4	25/3	3/4	17/4	4/6	3/4	6/6	29/4	25/4	1/10	7/10

Table (6): Yield characteristics of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons.

Cultivar	Yield/tree (Kg.)		Total No. Of fruits /tree		Cracked fruits (%)		Sun-burnt fruits (%)		Marketable fruits (%)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Tahreer	24.03 B	27.12 C	92.67 B	99.33 A	9.71 C	11.75 B	14.38 AB	12.76 A	75.89 C	75.51 AB
Badr	20.07 C	24.26 D	88.33 C	92.67 B	9.43 C	11.15 B	12.08 C	10.79 A	78.49 B	75.89 AB
Wardy	20.36 C	18.56 E	96.67 B	79.67 C	11.04 BC	12.14 B	6.55 D	11.71 A	82.41 A	84.10 A
Nab El-Gamal	30.35 A	46.55 B	112.33 A	104.00 A	10.09 C	12.50 B	10.39 C	11.22 A	79.52 B	76.28 AB
Araby	21.50 BC	25.21 CD	75.00 D	71.00 D	15.11 A	15.49 A	12.44 BC	12.68 A	72.44 D	71.37 B
Manfalouty	32.91 A	51.66 A	76.67 D	88.67 B	13.04 AB	12.03 B	15.22 A	11.28 A	71.74 D	77.06 AB

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

Table (7): Fruit quality characteristics of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons.

Cultivar	Fruit length (cm)		Fruit width (cm)		Fruit shape index		No. Of rooms/fruit		Fruit volume (cm^3)		Rind thickness (cm)		Av. Fruit weight (gm)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Tahreer	7.73 BC	7.43 D	7.73 BC	7.63 D	1.00 A	0.97 AB	6.00 A	6.00 A	260.00 C	374.00 C	0.50 AB	0.60 B	259.43 B	273.00 D
Badr	7.43 C	8.17 C	7.60 CD	8.13 C	0.98 A	1.00 AB	5.67 AB	6.00 A	253.33 C	263.33 D	0.31 C	0.39 C	227.10 C	261.83 D
Wardy	7.77 BC	7.70 D	7.37 D	7.60 D	1.05 A	1.01 A	5.33 B	5.00 B	246.67 C	303.33 D	0.34 C	0.37 C	210.73 C	232.87 E
Nab El-Gamal	8.43 A	9.03 B	7.83 BC	8.93 B	1.08 A	1.01 A	6.00 A	5.00 B	306.67 B	522.00 B	0.44 B	0.63 B	270.10 B	447.67 B
Araby	8.23 AB	8.30 C	8.00 B	8.77 B	1.03 A	0.95 B	5.33 B	5.00 B	270.00 C	408.33 C	0.48 AB	0.60 B	286.60 B	355.00 C
Manfalouty	8.67 A	9.53 A	8.67 A	10.10 A	1.00 A	0.94 B	5.00 B	5.00 B	433.33 A	650.00 A	0.52 A	0.69 A	429.67 A	582.67 A

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

Table (7) *Continued*:

Cultivar	*Rind and capillary membranes fresh weight /fruit (gm)		**Aril weight/fruit (gm)		*Rind and capillary membranes weight (%)		Seed weight/fruit (gm)		Aril /fruit weight ratio		Juice volume (cm^3)		No. Of arils/fruit	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Tahreer	124.4 BC	127.0 D	135.03 BC	145.97 C	47.98 AB	46.57 CD	44.93 BC	57.30 C	0.52 A	0.53 AB	115.00 B	98.43 DE	486.67 B	437.33 D
Badr	106.5 C	114.5 DE	120.60 CD	147.37 C	46.93 AB	43.72 D	33.60 D	53.83 CD	0.53 A	0.56 A	82.33 C	104.33 CD	504.67 B	500.33 C
Wardy	105.9 C	111.4 E	104.83 D	121.47 D	50.25 A	47.85 CD	27.57 E	45.70 D	0.50 A	0.52 A-C	84.00 C	86.67 E	312.67 D	361.67 E
Nab El-Gamal	125.3 BC	243.6 B	144.77 BC	204.10 B	46.39 B	54.40 AB	45.67 B	87.33 B	0.54 A	0.46 CD	90.67 C	138.33 B	565.67 A	623.33 B
Araby	139.3 B	204.3 C	147.27 B	150.67 C	48.62 AB	57.55 A	39.63 C	59.00 C	0.51 A	0.42 D	106.67 B	111.67 C	393.00 C	519.67 C
Manfalouty	183.7 A	296.2 A	245.97 A	286.47 A	42.74 C	50.83 BC	56.43 A	97.37 A	0.57 A	0.49 BC	127.33 A	271.67 A	488.33 B	770.00 A

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

*Rind and capillary membranes (non-edible part).

**Aril (edible part).

Table (8): Some fruit physical characteristics of the studied pomegranate cultivars under Souhag Governorate conditions.

Cultivar	Fruit rind touch	Fruit ribs	Seed toughness	Fruit shape	Fruit neck	Rind color	Aril color	Juice taste
Tahreer	Smooth	Clear	Soft	Rounded	Medium	Yellow-green blushed red	Light pink	Sweet
Badr	Medium	Medium	Soft	Rounded	Clear	Yellow blushed red.	Light pink	Sweet
Wardy	Medium	Rounded	Intermediate	Rounded	Clear	Pink blushed yellow	Light pink	Sweet with low acidity
Nab El-Gamal	Rough	Medium	Hard	Rounded	Very clear	Yellow-green blushed red	Light pink	Sweet with desirable acidity
Araby	Rough	Medium	Intermediate	Rounded	Very clear	yellow to green and shiny rind with patches of light pink	Very light pink	Sweet
Manfalouty	Very smooth	Clear	Intermediate	Rounded	Very clear	Red – pink, highlighted with beautiful dark red color.	Dark red to purple red	Sweet with desirable acidity

Table (9): Some fruit chemical characteristics of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons.

Cultivar	Reducing-sugars (%)		Non-reducing sugars (%)		Total Sugars (%)		T.S.S. (%)		Acidity (%)		T.S.S. / Acidity ratio		Vitamin (C) mg ascorbic acid/100ml juice		Tannins (%)		Total rind anthocyanin (%)		Total Juice anthocyanin (%)	
	2008	2008	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Tahreer	12.58 B	12.78 B	0.96 A	0.73 A	13.55 C	13.51 B	14.00 AB	12.33 C	0.91 C	0.81 E	15.41 A	15.30 AB	17.35 C	18.39 B	2.53 B	2.62 C	0.19 CD	0.19 B	0.40 D	0.39 E
Badr	14.10 A	14.09 A	1.14 A	0.68 A	15.24 AB	14.77 A	13.43 B	12.97 BC	0.87 C	0.91 D	15.40 A	14.20 BC	15.65 D	15.15 C	2.49 BC	2.71 B	0.25 B	0.24 A	0.45 CD	0.46 CD
Wardy	14.07 A	14.03 A	0.87 A	0.76 A	14.94 B	14.80 A	12.37 C	12.30 C	0.84 C	0.80 E	14.78 A	15.44 A	13.19 E	13.16 D	2.38 C	2.48 D	0.16 D	0.15 B	0.45 CD	0.48 BC
Nab El-Gamal	12.41 B	12.55 B	0.94 A	0.62 A	13.35 C	13.17 B	13.57 B	13.80 B	1.36 A	1.38 B	9.98 C	10.00 D	13.55 E	13.52 CD	2.19 D	2.18 E	0.24 B	0.25 A	0.47 BC	0.41 DE
Araby	14.42 A	14.38 A	1.25 A	0.60 A	15.67 A	14.98 A	12.33 C	13.60 B	1.07 B	1.01 C	11.53 B	13.47 C	18.95 B	18.47 B	2.06 E	2.22 E	0.21 C	0.26 A	0.54 B	0.53 B
Manfalouty	14.63 A	14.45 A	0.72 A	1.02 A	15.35 AB	15.47 A	14.73 A	15.27 A	1.44 A	1.46 A	10.26 BC	10.47 D	23.21 A	24.07 A	2.85 A	2.93 A	0.29 A	0.25 A	0.64 A	0.61 A

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

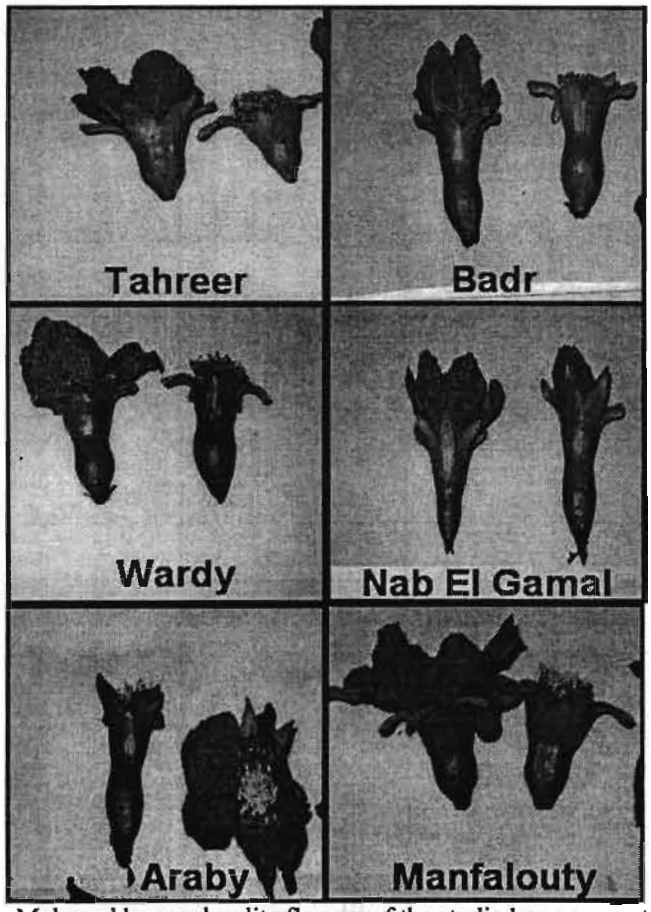

Figure (6): Male and hermaphrodite flowers of the studied pomegranate cultivars.

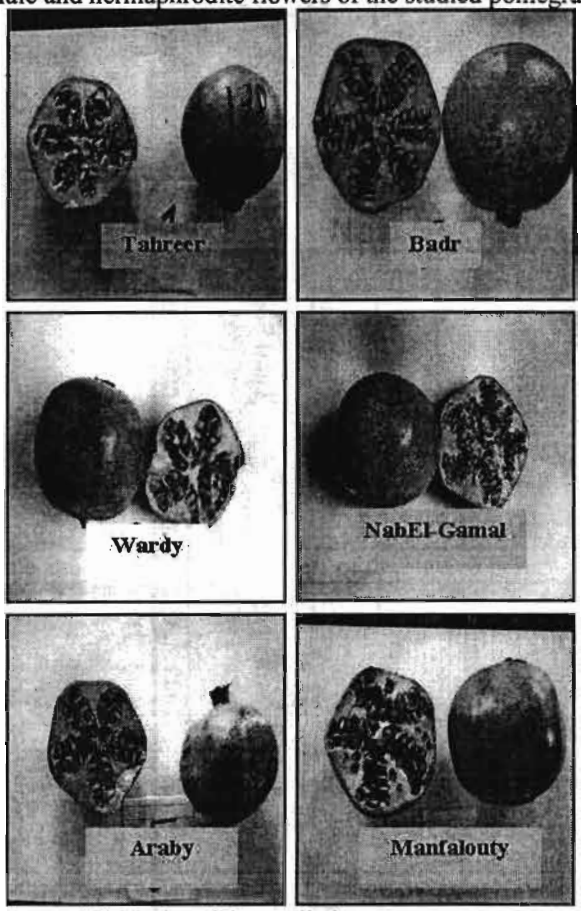

Figure (7): Fruits of the studied pomegranate cultivars.

Table (10): Aril mineral composition of the studied pomegranate cultivars under Souhag Governorate conditions during 2008 & 2009 seasons

Cultivar	N (%)		P (%)		K (%)		Ca (%)		Zn (ppm)		Cu (ppm)		Mn (ppm)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Tahreer	1.35 A	1.26 A	1.17 BC	1.25 A	1.49 B	1.53 C	1.35 D	1.40 C	1.64 C	1.65 C	1.63 AB	1.88 BC	1.25 C	1.31 D
Badr	1.27 B	1.25 A	1.07 DE	1.16 C	1.52 A	1.59 B	1.41 C	1.36 D	1.84 BC	2.08 A	2.01 AB	2.12 A	1.38 BC	1.52 B
Wardy	0.97 E	0.87 E	1.25 A	1.26 A	1.41 C	1.46 DE	1.52 A	1.52 B	1.75 BC	1.97 B	1.47 B	1.61 D	1.45 B	1.41 C
Nab El-Gamal	1.16 C	1.07 C	1.12 CD	1.15 C	1.48 B	1.51 CD	1.32 E	1.26 E	2.24 A	2.15 A	2.07 A	1.97 B	1.32 BC	1.33 D
Araby	0.97 E	0.98 D	1.22 AB	1.21 B	1.40 C	1.43 E	1.44 B	1.40 C	1.84 BC	1.91 B	1.50 AB	1.95 B	1.43 B	1.52 B
Manfalouty	1.14 D	1.16 B	1.03 E	1.03 E	1.53 A	1.69 A	1.51 A	1.57 A	2.06 AB	2.07 A	1.81 AB	1.80 C	1.79 A	1.97 A

Means in each season having the same letter/s are not significantly different at 5% level using Duncan's Multiple Range Test.

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دراسة مقارنة على بعض أصناف الرمان النامية تحت الظروف البيئية لمحافظة سوهاج

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أجريت هذه الدراسة بالمزرعة البحثية لمحطة بحوث البساتين بشندويل – محافظة سوهاج – مصر، خلال موسمى الدراسة ٢٠٠٨ & ٢٠٠٩لدراسة سلوك ستة أصناف محلية للرمان وتشمل: ، تحرير، ، بدر، وردى، ناب الجمل، عربى ، منفلوطى.وقد شملت الدراسة صفات النمو الخضرى– التزهير – المحصول صفات جودة الثمار الفيزيائية والكيماوية. كانت هناك اختلافات معنوية واضحة لصفات النمو الخضرى المدروسة. وقد أعطى صنف المنفلوطى أعلى عدد للأوراق والأفرع والأزهار الخنثى/الفرخ الخضرى وكذلك أعلى سمك لجذع الشجرة. أما صنف بدر فقد أعطى أكبر عدد للأزهار الكلية والمذكرة وكذلك أعلى نسبة للعقد(%)، ولكنه أظهر أقل القيم لعدد الأزهار الخنثى والنسبة الجنسية. كان أكبر عدد للأفرخ الخضرية/الشجرة وأطولها، وكذلك أطول الأشجار وأكبرها لمحيط الشجرة كانت لصنف تحرير. عموما يمكن ملاحظة أن بداية وانتهاء تفتح الأزهار المذكرة قبل تفتح الأزهار الخنثى، وقد كان صنف بدر الأكثر تبكيرا فى هذا المجال. بالنسبة لمواعيد تفتح الأزهار الخنثى وكذلك نسبة العقد، وكان بدر يليه العربى والوردى أكثر الأصناف تبكيرا، فى حين أن المنفلوطى الأكثر تأخيرا. وأفضل الأصناف من حيث الإنتاجية هو صنف المنفلوطى يليه ناب الجمل. وعلى العكس من ذلك صنف الوردى الذى سجل أقل محصول لموسمى الدراسة. ومن الجدير بالذكر أن الحد الأدنى لنسبة تشقق الثمار (٩,٤٣، ١١,١٥%) سجل لصنف بدر، ولكن كانت الأعلى فى صنف العربى (١٥,١١ ، ١٥,٤٩%). أما صنف تحرير فقد سجل أعلى القيم للثمار المصابة بلفحة الشمس/ الشجرة، فى حين أن صنف الوردى فقد كان الأقل. من وجهة النظر الاقتصادية سجل صنف العربى أقل عدد للثمار القابلة للتسويق (٧٢,٤٤ ، ٧١,٣٧ ٪) ، ولكن صنف الوردى تفوق على الأصناف الأخرى فى هذا المجال حيث سجل ٨٢,٤١ ، ٨٤,١٠ ٪ في كلا الموسمين على التوالي.

وقد اختلفت معظم صفات الجودة للثمار بين الموسمين ، حيث كانت أعلى في الموسم الثانى ، وقد يرجع ذلك بسبب التغيرات البيئية خلال موسمي الدراسة. وقد أظهر صنف المنفلوطى تفوقا بالنسبة لصفات الجودة أما صنف الوردى كان أقلها، علاوة على ذلك فإن الصنفين سابقى الذكر سلكا نفس الاتجاه بالنسبة للجزء غير القابل للأكل (القشرة، الأغشية الداخلية)، الوزن الطازج وكذلك وزن القشرة والبذور. كان صنف المنفلوطى الأفضل لمكونات العصير الكيماوية فيما عدا النسبة المئوية للسكريات غير المختزلة حيث لم تصل الاختلافات لمستوى المعنوية. أظهرت نتائج التحليل الكيماوى للعناصر اختلافات معنوية لكل العناصر المدروسة.

عموما فإنه تحت نفس الظروف لهذه الدراسة يمكن أن نوصى بالأصناف التالية:

صنف المنفلوطى حيث أنه يتميز بالإنتاجية العالية وكذلك تفوق على الأصناف الأخرى بالنسبة لصفات جودة الثمار وكذلك مكونات العصير ، أما صنف الوردى فقد أعطى أعلى نسبة للثمار القابلة للتسويق (%)، كما يعتبر أصناف بدر والعربى والوردى أصناف مبكرة.