Journal of Horticultural Science & Ornamental Plants 15 (2): 44-52, 2023
ISSN 2079-2158

DOI: 10.5829/idosi.jhsop.2023.44.52

Flowering and Fruiting of Some Mango Cultivars Grown under Different Governorates

[1]Samia S. Hosny, [1]M.F. El-Kholy, [1]Rania A.E. Abdelzaher and [2]E.A. Madboly

[1]Tropical fruits Research Department, Horticulture Research Institute,
Agricultural Research Center, Giza, Egypt
[2]Date Palm Laboratory for Research and Development, Agricultural Research Center, Giza, Egypt

Abstract: This work was done during 2019 and 2020 seasons on three new mango cultivars namely: Shelly, Naomi and Osteen. Trees were 12-years-old, grafted on mango Succary rootstocks, planted on sandy soil at 3 × 4 apart and irrigated with drip irrigation system. The selected cultivars were grown in private orchard under three different climatic conditions i.e. Aswan, Ismailia and El-Behera governorates. In each location the dates of the start and end of flowering and the beginning of harvest were observed, also leaf area, panicle length, number of fruits per tree, fruit quality, yield and numerical evaluation were determined. Results show that, mango shelly was the earliest cultivars to flowering compared with Osteen or Naomi. Notwithstanding that, the duration period was shortest and equal to both Shelly and Osteen cvs.(from 4 to 6 weeks) comparative with Naomi cv. in all governorates. Leaf area and panicle length of all cultivars recorded highest values in Ismailia followed by Aswan and El-Behera in descending order. Fluctuation in environmental conditions caused a significant difference in number of fruits /tree, fruit weight and yield for Shelly, Osteen and Naomi mango cultivars. Flowering malformed and fruit peel color had no significant effect under three governorates condition and peel color didn't affected too. Total soluble solids and total sugars influence by temperature fluctuation. The data showed significant differences between the three studied regions for each cultivar. Data clarified that ascorbic acid content differed significantly in the three regions these percentages can be arranged in descending order as follows; Aswan, Ismailia then El-Behera. Data pertaining the general evaluation of the Mango cultivars grown in three different governorates revealed that Shelly which grown in Ismailia region was seemed to be the highest in the general evaluation score (93.1 unit) in the average of two seasons followed by Aswan (91.7 units) and at least El-Behera governorates (84 units). In other words Shelly -Ismailia ranked first in total score units of yield (30/30) and in the second position of fruit quality (64 /70). While Shelly-Aswan ranked Second position in yield (23.9/30) and first position in fruit quality (67.8/ 70). Shelly-Behera came at least which recorded (14.87/30) yield and fruit quality (63.3/70). Concerning Osteen cultivar data showed that, Ismailia region was the best condition which recorded the highest number of evaluation (96.7 unit) compared with ones. In other words Osteen -Ismailia ranked first in total score units of both yield (30/30) and fruit quality (66.9 /70). While Shelly-Aswan ranked Second position in yield (23.8/30) and fruit quality (66.5/ 70). Shelly-Behera came at least which recorded (19.4/30) yield and fruit quality (64.6/70). Naomi cultivar recorded (93.6 units) in Ismailia region. Which Naomi -Ismailia ranked first in total score units of yield (30/30) and in the second position of fruit quality (63.4 /70). While Naomi-Aswan ranked Second position in yield (24.2/30) and first position in fruit quality (64.2/ 70). Naomi-Behera came at least which recorded (18.3/30) yield and fruit quality (61.8/70). It can be concluded that Ismailia region was the best location for three mango cultivars (Shelly, Osteen and Naomi), in Aswan region, Shelly cultivar gave the best yield and fruit quality while in El-Behera region we found that, was excellent cultivar in general evaluation under study conditions.

Key word: Shelly · Naomi · Osteen · Climate change · Temperature fluctuation Ismailia · Aswan · Nubaria

Corresponding Author: Samia S. Hosny, Tropical fruits Research Department,
Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

INTRODUCTION

Mango, is one of the most widely cultivated and popular fruits in the tropical and the subtropical climate for its economic and nutritional values. The optimum growth of most tropical fruits is about 24-30°C. However, mango trees can tolerant temperatures up to 48°C for short periods but are sensitive to temperature below 10°C [1]. Higher temperatures (> 45°C) or higher levels of light intensity are detrimental to the photosynthesis process. Mango grows successfully throughout Egypt from the relatively cool coast of Mediterranean sea (lat. 31°. 30' N) up to the burning heat of Aswan Governorate (lat. 22° N). Some previously introduced mango cultivars of excellent fruit quality were successfully grown under different region conditions in Egypt as Keitt, Naomi and Tommy Atkins [2]. New imported mango cultivars are important for crop improvement programs in different climate conditions. Global warming is inevitably happening and affects many aspect of life on earth. More fluctuation in temperature, rainfall, occurrence of frequent drought, floods, storms are likely expressions of climate change. Temperature plays a very important role in fruit bud differentiation and fruit set of tropical fruits. Global climate changes, high temperature and drought will tolerate up to a certain point with the genetic diversity of mango. So, rapid climate change should be a great concern irrespective of mango growers, scientists and buyers [3]. Temperature is known to affect both photosynthesis and respiration and their ratio must be high in order to achieve high yield [4]. Photosynthetic activity increases with temperature until certain level but further increase in temperature results inactivation of enzymes thus reduces the ability to cope with heat stress. Temperatures above 35°C are considered to stop ripening process in climacteric fruit as it suspends ethylene production. Zhang *et al.* [5] reported very high response of heat stress. Presently the impact of climate change on tropical fruits has been somewhat neglected probably with assumption that these fruits are already adapted to hot and humid conditions and also due to difficulty attached in experimentation with perennial, however, there are reports of impacts, most notably on tree phenology, especially flowering and fruiting. Fruit crops have longer period of flowering thus stay exposed to climate variability. Temperature brings about changes in hormones needed for growth and development of trees. In these fruit species temperature play important role in flower bud differentiation as well as flowering and fruit set. Symptoms like early blooming and advanced crop harvest has already been seen in some crops including mango and litchi [6].

The present study aimed to evaluate flowering and fruiting behavior of Shelly, Osteen and Naomi mango cultivars under each of Aswan, Ismailia and Nubaria regions, also expressing opinion about the best region of each mango cultivars established on fruit quality and yield.

MATERIALS AND METHODS

This work was done during 2019 and 2020 seasons on three new mango cultivars namely: Shelly, Naomi and Osteen. Trees were 12-years-old, grafted on Succary mango rootstocks, planted on sandy soil at 3 × 4 apart and irrigated with drip irrigation system grown in private orchards under three regions of different climatic condition i.e. Aswan Governorate (24°05'N, 32°53'E)., Ismailia Governorate (30°35'N, 32°16'E) and El-Behera Governorate (30° 40'N, 30°04'E). Table 1 show the maximum and minimum temperature for the three locations under study. All trees under study were in full production stage and received the same horticultural practices.

For this investigation nine trees for each cultivar were chosen in every region divided into three replicates and the following parameters were done:

Flowering Parameters: In each location the dates of the start and end of flowering and the beginning of harvest were observed according to El-Agamy *et al.* [2].

Panicle Length (cm): Was recorded at the end of flowering period.

Percentage of malformed panicles was determined by the following equation

Malformed percentage (%) =(Malformed panicles × 100) / Total panicles.

Leaf Area (cm²): Leaf sample from each tree (10 leaves) were chosen (4th and 5th leaves from the shoot base) and leaf area (cm²) was measured according to Ahmed and Morsy [7] using the following equilibration: Leaf area = 0.70 (length x width) + 1.06 [8].

Table 1: Maximum and Minimum Temperature for Region location and habitat condition of Mango cultivars trees accessions at 2019

	Region					
	Aswan		Ismailia		El-Behera	
Month	Max Tem.°C	Min Tem.°C	Max Tem.°C	Min Tem.°C	Max Tem.°C	Min Tem.°C
January	22	7	18	9	18	7
February	28	12	21	10	21	8
March	34	16	21	10	22	8
April	35	18	25	12	21	8
May	40	24	30	17	32	16
June	42	26	32	19	33	17
July	41	26	34	19	35	21
August	41	26	33	19	35	22
September	41	25	33	19	35	21
October	36	21	29	17	32	18
November	28	14	24	14	27	14
December	22	8	22	11	22	10

Data were obtained from the agrometeorological Unit at Center Laboratory for Agriculture Climate (CALC), Agriculture Research Center.

Fruiting Parameters

Fruit Retention (%): Was determined at harvest by the following equation: Final fruit set/ Initial fruit set X 100 (Initial fruit set was determined as number of setting fruits per panicle two weeks after petal fall for panicles on tagged shoots. And final fruit set was determined by counting number of retained fruits per panicle at harvest (First week of August).

Number of Fruits / Tree: At maturity stage number of fruits per tree was counted.

Yield (Kg) Per Tree: Was estimated by multiplying number of fruits per tree X the average of fruit weight.

Fruit Properties: Samples of 10 ripe fruits were taken randomly from each cultivar at harvest stage to determine. Fruit peel color by using color chart, fruit weight (g). T.S.S. % by using handy refractometer, Total acidity % (as g citric acid/ 100 g pulp), percentages of total sugars and vitamin C (mg/100 ml juice), were determined as described by A.O.A.C. [9]

General Evaluation of the Tested Regions: The final evaluation of all tested regions was calculated on the basis of 100 units which were shared between tree yield (30 units), days to harvest (20 units), fruit retention (10 units), fruit weight (10 units), total sugar (10 units), malformation percent (10 units) and fruit peel color (10 units) [2]. Each tree that gave the best results in any property took the full mark specified for this property, while each of the other tested trees took lower units equal to their quality.

Statistical Analysis: A split plot design in 3 replicate was followed as experimental design where cultivars put in main plots and regions in sub-main plot. The experimental data were tabulated and statistically analyzed according to Snedecor and Cochran [10] and the differences between mean various treatments were compared by using New L.S.D. at 5% level of probability [11].

RESULTS

Flowering and Fruiting: The obtained results in (Table 2) clearly showed that, flowering started early in Aswan (3rd week of February) while trees at Ismailia began flowering later (1st of March) and trees grown under El-Behera condition began flowering on 2nd week of March for both seasons. Flowering period extended from 4 to 6 weeks for trees under the different studied conditions, in both studied seasons. Table (2) showed that, time to maturity of all mango cultivars under this investigation ranged between 11-16 weeks to reach maturity stage. Harvest date began earlier (first week of June) at Aswan region and required 11-14 weeks (from flowering to harvest).

Under Ismailia conditions, harvest date began (first week of July) and needed to maturity about 12-16 weeks while under El-Behera trees start flowering at 3rd week of July and reach to maturity 12 weeks-in the first and second season. Results in Tables (2 & 3) show that, mango Shelly was the earliest cultivars to flowering compared with Osteen or Naomi. Notwithstanding that, the duration period was shortest and equal to both Shelly and Osteen cvs. (from 4 to 6 weeks) comparative with Naomi cv. in all governorates.

Table 2: Beginning, full blooming and flowering duration of four mango cultivars grown in Aswan, Ismailia and El-Behera governorates during 2019 &2020 seasons

	Governorates								
	Aswan			Ismailia			El-Behera		
Cultivars	Began	End	Duration	Began	End	Duration	Began	End	Duration
					First season				
Shelly	3rd week of Feb.	2nd week of Mar.	4 weeks	1st week of Mar.	1st week of Apr.	5 weeks	2nd week of Mar.	3rd week of Apr.	6 weeks
Osteen	4th week of Feb.	3nd week of Mar.	4 weeks	2nd week of Mar.	2nd week of Apr.	5 weeks	3rd week of Mar	4th week of Apr.	6 weeks
Naomi	4th week of Feb.	4st week of Mar.	5 weeks	1st week of Mar.	1st week of Apr.	5 weeks	2nd week of Mar	3rd week of Apr.	6 weeks
					Second season				
Shelly	3rd week of Feb.	2st week of Mar.	4 weeks	1st week of Mar.	1st week of Apr.	5 weeks	2nd week of Mar.	3rd week of Apr.	6 weeks
Osteen	4th week of Feb..	3nd week of Mar.	4 weeks	2nd week of Mar.	2nd week of Apr.	5 weeks	3rd week of Mar	4th week of Apr.	6 weeks
Naomi	3rd week of Feb.	2st week of Mar.	4 weeks	1st week of Mar.	1st week of Apr.	5 weeks	2nd week of Mar	3rd week of Apr.	6 weeks

Table 3: Harvest date and days to maturity of four mango cultivars grown in Aswan, Ismailia and El-Behera governorates during 2019 &2020 seasons

	Governorates					
	Aswan		Ismailia		El-Behera	
Cultivars	Harvest date	Days to maturity	Harvest date	Days to maturity	Harvest date	Days to maturity
	First season					
Shelly	2nd week of Jun.	14 week	3rd week of Jul	15 week	4th week of Jul.	15 week
Osteen	1st week of Jun.	11 week	1st week of Jul.	12 week	3rd week of Jul.	12 week
Naomi	4th week of Jun	12 week	4th week of Jul	16 week	1st week of Aug.	15 week
	Second season					
Shelly	2nd week of Jun.	14 week	3rd week of Jul	15 week	4th week of Jul.	16 week
Osteen	2nd week of Jun.	11 week	2nd week of Jul	12 week	4th week of Jul.	12 week
Naomi	3rd week of Jun	12 week	3rd week of Jul.	16 week	1st week of Aug.	15 week

Osteen cultivar harvested in early season and required to maturity between 11 -12 weeks, Shelly cultivar came in intermediate (mid) season with need about 14-16 weeks to maturity. Naomi recorded 12-16 weeks to maturity and came in late season through the two seasons. In general, the studied mango cultivars trees cover a long period in the season extends from 1st week of Jun till 1st week of Aug.

Leaf Area, Panicle Length and Fruit Retention Percent: Table (4) shows that, leaf area and panicle length of all cultivars was significantly affected by different regions. The highest values were recorded in Ismailia followed by Aswan and El-Behera in descending order. Similar trend was noticed for both leaf area and panicle length. All cultivars (Shelly, Osteen and Naomi) trees recorded the highest value of leaf area and panicle length in Ismailia region. Despite of the fruit retention percent recorded the elevated value in El-Behera region followed by Ismailia and at the least in Aswan for all studied cultivars at two seasons.

Malformed Panicle Number, Malformed Percentage and Color Fruit Peel: The data in Table (6) showed non significant differences between the three studied regions for each cultivar. Shelly cultivar recorded the highest values in Aswan followed by Ismailia and El-Behera in descending order. While Osteen and Naomi cultivars were the same trend which gave the best percent in Ismailia and El-Behera but the lowest percent of malformed was recorded in Aswan region.

Number of Fruits /Tree, Fruit Weight and Yield: Data in Table (5) indicated that fluctuation in environmental conditions caused a significant difference in number of fruits /tree, fruit weight and yield for Shelly, Osteen and Naomi mango cultivars. Ismailia region recorded the highest number of fruits per tree for both the Shelly and Osteen cultivars. While the greatest number fruit per trees for Naomi cultivar was recorded in the Aswan region. Furthermore, fruit weight and yield per tree gave the highest values in Ismailia region for the three cultivars (Shelly, Osteen and Naomi) followed by El-Behera.

T.S.S%, Vitamin C and Total Sugars: Total soluble solids and total sugars influence by temperature fluctuation that clear in Table (7). The data showed significant differences between the three studied regions for each cultivar. Shelly cultivar recorded the highest values in Aswan followed by Ismailia and El-Behera in descending order. While Osteen and Naomi cultivars were the same trend which gave the best percent in Ismailia and El-Behera but the lowest percent of T.S.S was recorded in Aswan region.

Table 4: Leaf area (cm^2), panicle length (cm) and fruit retention % of mango tree cultivars grown in Aswan, Ismailia and El-Behera governorates during 2019 and 2020 seasons

	Leaf area (cm^2)				Panicle length (cm)				Fruit retention (%)			
Governorates	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi	Mean (B)
						First season						
Aswan	62.6	61.9	76.8	67.1	29.1	31.5	32.0	30.9	68.0	75.0	75.0	72.7
Ismailia	67.8	63.6	78.2	69.9	30.1	32.0	32.0	31.4	71.5	79.2	79.0	76.6
El-Behera	60.5	62.3	77.9	66.9	29.1	32.0	31.9	31.0	74.2	80.0	80.0	78.1
Mean (A)	63.6	62.6	77.6		29.4	31.8	31.97		71.2	78.1	78.0	
New L.S.D at 5%	A = 1.348 B = 1.482 AxB = 2.432				A=0.637 B=0.819 AxB =1.183				A = 1.438 B = 1.592 AxB = 2.432			
						Second season						
Aswan	60.0	59.9	76.0	65.3	28.9	31.5	31.9	30.8	65.7	73.2	71.4	70.1
Ismailia	61.3	61.5	77.3	66.7	28.7	32.7	32.0	31.1	71.2	79.3	75.6	75.4
El-Behera	60.4	60.5	76.7	65.9	29.2	31.2	31.0	30.5	75.2	80.5	78.3	78.0
Mean (A)	60.6	60.6	76.7		28.9	31.8	31.6		70.7	77.7	75.1	
New L.S.D at 5%	A = 1.297 B = 1.392 AxB = 2.117				A=0.629 B=0.0.813 AxB =1.169				A = 1.397 B = 1.492 AxB = 2.317			

Table 5: Number of fruits / tree, fruit weight (g) and yield (kg/ tree) of mango tree cultivars in Aswan, Ismailia and El-Behera governorates during 2019 and 2020 seasons

	Number of fruits / tree				Fruit weight (g)				Yield (kg/tree)			
Governorates	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi	Mean (B)
						First season						
Aswan	65.0	40.0	50.0	51.7	310.0	690.0	506.0	502.0	20.2	27.6	25.3	24.4
Ismailia	64.0	47.0	53.0	54.7	315.0	727.0	591.0	544.3	20.2	34.2	31.3	28.6
El-Behera	46.0	38.0	39.0	41.0	272.0	590.0	490.0	450.7	12.5	22.4	19.1	18.0
Mean (A)	58.3	41.7	47.3		299.0	669.0	529.0		17.6	28.1	25.2	
New L.S.D at 5%	A = 1.348 B = 1.482 AxB = 2.432				A=5.637 B=20.819 AxB =1.183				A = 1.438 B = 1.592 AxB = 2.432			
						Second season						
Aswan	60.0	34.0	40.0	44.7	330.0	702.0	520.0	517.3	19.8	23.9	20.8	21.5
Ismailia	69.0	38.0	33.0	46.7	360.0	750.0	570.0	560.0	24.8	28.5	18.8	24.0
El-Behera	41.0	30.0	25.0	32.0	300.0	620.0	510.0	476.7	12.3	18.6	12.8	14.6
Mean(A)	56.7	34.0	32.7		330.0	690.7	533.3		18.9	23.7	17.5	
New L.S.D at 5%	A = 1.297 B = 1.392 AxB = 2.117				A=10.629 B=20.0.813 AxB =1.169				A = 1.397 B = 1.492 AxB = 2.317			

Table 6: Malformed panicle number, malformed percentage and color fruit peel of some mango cultivars grown in Aswan, Ismailia and El-Behera governorates during 2019 and 2020 seasons

	Malformed panicle number				Malformed percentage				Color fruit peel		
Governorates	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi
						First season					
Aswan	6.2	6.5	6.9	6.5	6.2	6.6	7	6.6	Yellow-orang	Red	Yellow-red
Ismailia	6.5	6.7	6.9	6.7	6.6	6.8	7	6.8	Yellow-orang	Red	Yellow-red
El-Behera	6.7	6.9	7	6.9	6.8	7	7.1	7.0	Yellow-orang	Red	Yellow-red
Mean (A)	6.47	6.70	6.93		6.53	6.80	7.03				
New L.S.D at 5%	A = NS B = NS				AxB = NS A=NS B=NS AxB =NS						
						Second season					
Aswan	6.2	6.6	7	6.6	1.2	1.6	1.8	1.5	Yellow-orang	Red	Yellow-red
Ismailia	6.6	6.8	7	6.8	1.6	1.6	1.8	1.7	Yellow-orang	Red	Yellow-red
El-Behera	6.8	7	7.1	7.0	1.6	1.7	1.8	1.7	Yellow-orang	red	Yellow-red
Mean (A)	6.53	6.80	7.03		1.47	1.63	1.80				
New L.S.D at 5%	A = NS B = NS AxB = NS				A=NS B=NS AxB =NS						

Table 7: T.S.S. %, Vitamin C (mg/100 ml juice) and total sugars % of some mango cultivars grown in Aswan, Ismailia and El-Behera governorates during 2019 and 2020 seasons

	T.S.S. (%)				Vitamin C (mg/100 ml juice)				Total sugars (%)			
Governorates	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi	Mean (B)	Shelly	Osteen	Naomi	Mean (B)
						First season						
Aswan	17.8	15.0	12.7	15.2	52.2	50.1	44.9	49.1	13.7	12.6	10.9	12.4
Ismailia	13.0	19.0	17.0	16.3	52.1	49.9	44.8	48.9	11.2	14.6	14.1	13.3
El-Behera	13.0	18.0	15.0	15.3	51.9	50.0	44.0	48.6	10.9	13.9	12.6	12.5
Mean (A)	14.6	17.3	14.9		52.1	50.0	44.6		11.9	13.7	12.5	
New L.S.D at 5%	A=0.651 B=0.713 AxB =1.126				A=0.637 B=0.819 AxB =1.183				A = 1.438 B = 1.592 AxB = 2.432			
						Second season						
Aswan	16.0	17.0	15.0	16.0	52.2	50.1	44.9	49.1	12.3	13.0	12.6	12.6
Ismailia	14.0	19.0	17.0	16.7	52.1	49.9	44.8	48.9	10.3	14.6	13.2	12.7
El-Behera	14.0	17.0	15.0	15.3	51.9	50.0	44.0	48.6	10.3	13.2	12.6	12.0
Mean(A)	14.7	17.7	15.7		52.1	50.0	44.6		11.0	13.6	12.8	
New L.S.D at 5%	A=0.689 B=0.725 AxB =1.147				A=0.490 B=0.539 A×B =1.874				A = 1.397 B = 1.492 AxB = 2.317			

Tab1e 8: General evaluation (as average two seasons) of three Mango cultivars grown under Ismailia, Aswan and El-Behera governorates

		Fruit quality (70 units)							
		20	10	10	10	10	10		
Cultivars	Yield Per tree Units (30)	Days to maturity	Fruit retention %	Fruit weight	Total sugars	Fruit peel color Cultivars	Malformation	Total score of fruit quality (70 units)	General evaluation (100 units)
Shelly-Aswan	23.90	20	8.7	9.1	10.0	10.0	10.0	67.80	91.70
Shelly- Ismailia	30.00	17	9.4	10.0	8.2	10.0	9.4	64.00	94.00
Shelly-Behera	14.87	18	10.0	8.3	7.9	10.0	9.1	63.30	78.17
Osteen-Aswan	23.80	20	9.3	9.3	8.5	10.0	9.4	66.50	90.30
Osteen-Ismailia	30.00	18	9.8	10.0	10.0	10.0	9.1	66.90	96.90
Osteen-Behera	19.40	18	10.0	8.3	9.5	10.0	8.8	64.60	84.00
Naomi-Aswan	24.20	20	9.1	8.6	7.7	10.0	8.8	64.20	88.40
Naomi-Ismailia	30.00	15	9.6	10.0	10.0	10.0	8.8	63.40	93.40
Naomi-Behera	18.30	16	10.0	8.2	8.9	10.0	8.7	61.80	80.10

Fig. 1: Osteen, Naomi and Shelly mango cultivars grown in Aswan, Ismailia and El-Behera governorates.

Ascorbic Acid Content: The data in Table (7) clarified that ascorbic acid content differed significantly in the three regions these percentages can be arranged in descending order as follows; Aswan, Ismailia then El-Behera, this is clear in both studied seasons and Table (7). Shelly and Naomi save the similar trend in percent of ascorbic acid which recorded the highest value in Aswan followed by Ismailia and at least in El-Behera. Deposit, Osteen recorded the highest in Aswan too, but not significant effect in Ismailia or El-Behera.

Numerical Evaluation: Total score for yield and fruit quality (100). Data pertaining the general evaluation of the Mango cultivars grown in three different regions in Table (8) revealed that Shelly which grown in Ismailia region was seemed to be the highest in the general evaluation score (93.1 unit) in the average of two seasons followed by Aswan (91.7 units) and at least El-Behera governorates (84 units). In other words Shelly -Ismailia ranked first in total score units of yield (30/30) and in the second position of fruit quality (64 /70). While Shelly-Aswan ranked Second position in yield (23.9/30) and first position in fruit quality (67.8/ 70). Shelly-Behera came at least which recorded (14.87/30) yield and fruit quality (63.3/70). Concerning Osteen cultivar data showed that, Ismailia region was the best condition which recorded the highest number of evaluation (96.7 units) compared with ones. In other words Osteen -Ismailia ranked first in total score units of both yield (30/30) and fruit quality (66.9 /70). While Shelly-Aswan ranked Second position in yield (23.8/30) and fruit quality (66.5/ 70). Shelly-Behera came at least which recorded (19.4/30) yield and fruit quality (64.6/70). Naomi cultivar recorded (93.6 units) in Ismailia region. Which Naomi-Ismailia ranked first in total score units of yield (30/30) and in the second position of fruit quality (63.4 /70). While Naomi-Aswan ranked Second position in yield (24.2/30) and first position in fruit quality (64.2/ 70). Naomi-Behera came at least which recorded (18.3/30) yield and fruit quality (61.8/70). It can be concluded that Ismailia region was the best location for three mango cultivars (Shelly, Osteen and Naomi), in Aswan region, Shelly cultivar gave the best yield and fruit quality while in El-Behera region we found that, was excellent cultivar in general evaluation under study conditions.

DISCUSSION

Mango cultivation is primarily concentrated in the tropics (25°N, 25°S) and subtropics (35°N, 35°S), while some production also takes place in warm temperate/subtropical, or Mediterranean-type, regions. The best regions for mango production are cool and/or dry conditions just before flowering, followed by average soil moisture and averagely hot temperatures (30-33°C) [12]. Mango production areas include a variety of climatic and soil conditions, which shows how adaptable the species is and how cultural techniques have improved [13]. Weather variables have an impact on mango vegetation growth as well. Mango's vegetative and reproductive growth is strongly regulated by soil temperature, which is heavily influenced by ambient temperature [14]. The average leaf size of trees cultivated at 30/25°C (day/night temperature) in another experiment was 300% larger than that of trees planted at 20/15°C [15]. But for leaves that evolved in the 20 to 28°C range for the mean daily temperature, a group of experts found no discernible relationship between temperature and leaf size [16]. Both drought and flooding stunt the growth of mango trees, which has a detrimental influence on their vegetative development. Mango flowers are mostly caused by chilly temperatures. Therefore, higher temperatures during the induction of flowers should have a negative impact. However, pollen viability and fruit set would benefit from cooler temperatures during flowering that were followed by warmer temperatures. Suitable weather conditions, such as low nighttime temperatures (120°C) and soil moisture stress (-75 kpa or even less), are among the causes of mango flowering. Nevertheless, depending on the variety, moisture stress can greatly supplement the low temperature requirement and cause mango to flower. Despite having a mild winter prior to flowering, mango plants cultivated in light soils (which have the ability to lose moisture quickly) achieved superior flowering. Even when grown in lighter soils and under more moisture-stressed conditions, flowers in Himsagar (Khirsapati) had been the most severely impacted over the years. Utilizing growth inhibitors and applying moisture stress prior to flowering could augment intensifying the induction of flowers during the current mild winter (4 months dry period). In general, irregular/poor/no flowering was caused by low soil moisture stress brought on by the monsoon's delay up until the first fortnight of October as well as a lack of cool winters in late and vigorous cultivars like Aswina, Fazli, etc. planted in heavy soils. If the current state of affairs (global warming and climate change) continues. According to Dambreville *et al.* [16], higher temperatures are also detrimental to inflorescence size and the quantity of flowers per inflorescence [17]. Researchers found that mono and polyembryonic cultivars performed better in terms of vegetative growth at 30°C daytime and 25°C nighttime and floral induction at 15°C daytime and 10°C nighttime [18]. The amount of light has a beneficial impact on mango flowering. Because mango blossom is the most climate-sensitive stage, unfavourable environmental variables, such as rain, humidity, temperature, light, wind, drought, water logging, etc., have a negative impact. Drought and a larger vapour pressure deficit have a negative impact on fruit set and retention (VPD). Through encouraging early growth cessation, drought may inadvertently aid in the induction of flowers.

Mangoes are mainly cultivated in the tropics (25°N, 25°S) and subtropics (35°N, 35°S), although limited production also occurs in warm temperate/ subtropical, i.e. Mediterranean-type areas. The ideal areas for mango production have a cool and/or dry period prior to flowering followed by moderate soil moisture and moderately hot temperatures (30-33°C) [12]. The diversity of climates and soils in mango-production areas reflects the adaptability of the species and improvements in cultural practices [13].

Rising temperatures would have a positive effect on mango fruit growth. The estimated duration of mango fruit development in Australia decreased by 12-16 days (7-8%) as a consequence of the 1.5°C increase of winter temperatures over the last 45 years [19]. Higher temperature may be beneficial to fruit quality because of stress- induced by higher temperature helps to synthesis of secondary compounds which are involve to increase some nutritional value. However high temperature also induces physiological changes within the mango fruit. Spongy tissue, a physiological disorder in Alphonso mango, is induced by higher temperatures within the fruits, leading to tissue breakdown. In an experiment higher light intensity enhances skin colour for coloured cultivars [20]. Excessive light could also have a positive effect on fruit size by enhancing photosynthesis [21]. As higher CO2 concentration also enhances photosynthesis could have a positive effect on fruit quality by accumulating larger fruit dry mass. Drought has both positive and negative effect on fruit quality and well-known in non-irrigated orchards. Drought reduces fruit size [22]. But increases fruit quality by increasing the dry matter content and sugar concentration [23]. It can be suggested that, Ismailia region is the best to growing and fruiting with good fruit quality for Shelly, Osteen and Naomi mango cultivars followed by Aswan under this study.

REFERENCES

1. El-Sayed, M.E.A., Safaa M.A. El-nawam and Gehan G. Mostafa, 2018. Evaluation of local mango cultivars grown under different locations in Egypt using fruit quality and RAPD analysis. Middle East Journal of Agriculture Research, 7: 473-48.
2. El-Agamy, M.K., Hoda H. Aly and Samia S. Hosny, 2018. Flowering and fruiting behavior of some introduced mango cultivars grown in giza governorate conditions. Middle East Journal of Agriculture Research, 7: 559-56.
3. Shuvadeep Halder and M.D. Abu Hasan, 2020. Climate change and mango production. Chem. Sci. Rev. Lett., 9(33): 55-57.
4. Moretti, C.L., L.M. Mattos, A.G. Calbo and S.A. Sargent, 2010. Climate changes and of 50th Croatian and 10th international symposium on agriculture. Opatija. Croatia, pp: 42-45.
5. Zhang, L., Z. Yu, L. Jiang, J. Jiang, H. Luo and L. Fu, 2011. Effect of post-harvest heat treatment on proteome change of peach fruit during ripening. Journal of Proteomics, 74: 1135-1149.
6. Hribar, J. and R. Vidrih, 2014. Impacts of climate change on fruit physiology and quality, proceedings Intergovernmental Panel on Climate Change. (2000). IPCC special report on emissions scenarios. International, 43: 1824-1832.
7. Ahmed, F.F. and M.H. Morsy, 1999. A new method for measuring leaf in different fruit species. Minia J. Agric. Res. & Develop., 19: 97-105.
8. Serry, N.K.H., 2010. Evaluation of some mango strains growing under Ismailia conditions Research Journal of Agriculture and Biological Sciences, 6(6): 840-845.
9. A.O.A.C., 2000. Official method of analysis of association of official analysis chemists. 16th Ed. Association of Official Analytical Chemists. Washington. D.C., U.S.A.
10. Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods. 6 The Iowa St. Univ., Press. Amer., Iowa.th U.S.A., pp: 363-372.
11. Waller, P.A. and D.B. Duncan, 1969. Amer. States Assoc. J., pp: 1485-1503.
12. Chacko, E.K., 1986. Physiology of vegetative and reproductive growth in mango (*Mangifera indica* L.) trees. In: Proceedings of the First Australian Mango Research Workshop.
13. Crane, J.H., S. Salazar-Garcia, T.S. Ln, A.C. de Queiroz Pinto and Z.H. Shu, 2009. The Mango, 2nd Edition: Botany, Production and Uses (ed. R.E. Litz), pp: 432-83.
14. Yusof, I.M., D.W. Buchanan and J.F. Gerber, 1969. The response of avocado and mango to soil temperature. Journal of the American Society for Horticultural Science, 94: 619-612.
15. Whiley, A.W., T.S. Rasmussen, J.B. Saranah and B.N. Wolstenholme, 1989. Effect of temperature on growth, dry matter production and starch accumulation in ten mango (*Mangifera indica* L.) cultivars. J. Hort. Science, 64: 753-765.

16. Dambreville, A., F. Normand and P.E. Lauri, 2013. Plant growth co-ordination in nature: a unique temperature-controlled law among vegetative and reproductive organs in mango. Functional Plant Biology, 40:280-291.
17. Sukhvibul, N., A.W. Whiley, M.K. Smith, S.E. Hetherington and V. Vithanage, 1999. Effect of temperature on inflorescence development and sex expression of mono- and poly-embryonic mango (*Mangifera indica* L.) cultivars. J. Hort. Science & Biotech., 74: 64-68.
18. Whiley, A.W., T.S. Rasmussen, B.N. Wolstenholme, J.B. Saranah and B.W. Cull, 1991. Interpretation of growth responses of some mango cultivars grown under controlled temperature. Acta Hort., 291: 22-31.
19. Olesen, T., 2011. Late 20th century warming in a coastal horticultural region and its effects on tree phenology. New Zealand J. Crop Hort. Science, 39(2): 119-129.
20. Léchaudel, M., F. Lopez-Lauri, V. Vidal, H. Sallanon and J. Joas, 2013. Response of the physiological parameters of mango fruit (transpiration, water relations and antioxidant system) to its light and temperature environment. J. Plant Physiol., 170: 567-578.
21. Urban, L., X. Le Roux, H. Sinoquet, S. Jaffuel and M. Jannoyer, 2003. A biochemical model of photosynthesis for mango leaves: evidence for an effect of the fruit on photosynthetic capacity of nearby leaves. Tree Physiol., 23: 289-300.
22. Spreer, W., S. Ongprasert, M. Hegele, J.N. Wünsche and J. Müller, 2009. Yield and fruit development in mango (*Mangifera indica* L. cv. Chok Anan) under different irrigation regimes. Agric. Water Manage., 96: 574-584.
23. Léchaudel, M., J. Joas, Y. Caro, M. Génard and M. Jannoyer, 2005. Leaf: fruit ratio and irrigation supply affect seasonal changes in minerals, organic acids and sugars of mango fruit. Journal of the Science of Food and Agriculture, 85(2): 251-260.