Screening of Fifteen Pumpkin (*Cucurbita moschata*) Genotypes for Yield and Some Quality under Sohag Conditions

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Keywords: pumpkin accession, flesh thickness, genotypes, total soluble solids

Abstract

Eleven Egyptian landraces, two imported USA cultivars ('Etamp' and 'Butternut') and two Sudanese accessions (Khartoum and Omdurman) of pumpkin (*Cucurbita moschata* Duchesne) were assessed for yield and some fruit quality characteristics at the Experimental Farm, Faculty of Agriculture, Sohag University during two successive seasons, 2007 and 2008. There were significant differences among genotypes for all studied characters. 'Butternut' cultivar was the earliest in both female and male flower development but the lowest in fruit yield. Its fruits showed the least flesh thickness and the highest percent of total soluble solids (TSS). Khartoum accession was the latest to flower in both seasons. 'Etamp' cultivar exceeded all other genotypes in total fruit yield and fruit flesh thickness. Fruits of 'Bardis' Sohag accession had the lowest TSS in both seasons. The results of this study could be useful in breeding programs for improving pumpkin production in Upper Egypt.

INTRODUCTION

In Egypt, about 91816 feddan* of *Cucurbita* crops are cultivated annually. Pumpkin (*Cucurbita moschata* Duchesne) has been grown widely in Egypt and it is considered one of the major vegetable crops. Its fruits are processed in different dietary forms such as jams, purees and cakes. The seeds of several *Cucurbita* species are relatively rich in lipids and proteins and the roasted and salted seeds are commonly used as a nutritious snack. In some African countries, shoot tips of cucurbits are cooked and eaten as vegetable.

Many investigators studied the growth and yield variations among cucurbit species (Doijode et al., 1982; Rana et al., 1985; Doijode and Sulladmath, 1986; Mondal et al., 1989; Bost, 1991; Swamy and Dutta, 1991; Prasad and Singh, 1992; Damarany et al., 1995; Olson et al., 1995; Mohanty and Mishra, 1999; Vallejo et al., 1999a, b; Keinath and DuBose, 2000; Mohanty, 2000; Alsadon et al., 2002; White, 2002; Mostafa, 2006). Researchers and farmers have noted the deterioration in yield and fruit characteristics of local pumpkin cultivars. In general, there has been a limited research work on the improvement of cucurbits in Egypt. Ibrahim and co-workers were among the pioneers to initiate the *Cucurbitaceae* improvement program. They have released two sour-sweet melon (Ibrahim and Al-Zeir, 1992) and two desert-adapted winter squash (Ibrahim et al., 1996) cultivars. The objective of this study was to evaluate the performance of 15 local and introduced pumpkin genotypes for yield and some quality characteristics.

MATERIAL AND METHODS

Plant Materials

Fifteen pumpkin genotypes were used in the present study. Out of the 15 pumpkin genotypes, 11 were collected from various provinces in Egypt where they have been

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*Feddan is 4200 m^2, approximately 0.42 ha. The data were from the Ministry of Agriculture and Land Reclamation Statistics, 2005.

commonly grown for several decades. Two imported USA cultivars ('Etamp' and 'Butternut') and two accessions from different regions in Sudan (Khartoum and Omdurman) were included. Name, seed source and fruit characteristics (skin and flesh color and fruit size and shape) of the used locally and introduced pumpkins are shown in Table 1 and Figure 1.

Field Trial Layout

Two years field trial (2007 and 2008) was executed at the Experimental Farm of Faculty of Agriculture, Sohag University, Sohag, Egypt to evaluate the 15 pumpkin entries for fruit yield and quality characteristics. The two years trial was conducted using seeds from the same seed lots. The experimental design was a randomized complete block with 3 replications. Each experimental unit (plot) consisted of two ridges, each 3 m long and 4 m wide with plants 70 cm apart. Thus, each plot contained 8 plants occupying 24 m^2.

Seeds were directly planted in the field on August 25th in both seasons. Two to four seeds were sown per hill on one side of the ridge. Thinning of hills was carried out twice, the first was at the two leaf stage and the second was at the 4 to 5 true leaf stage, where finally one plant was left per hill. Fertilization, irrigation and other cultural practices were carried out as recommended for pumpkin commercial production (Hassan, 1991).

Data on vegetative and reproductive growth were taken at 90 days after sowing for the following characters: 1) vine length (m), 2) number of leaves per plant, 3) sex ratio (%, number of female flowers/total number of male flowers), 4) days to the first male flower, 5) nodes to the first male flower, 6) days to the first female flower, 7) nodes to the first female flower, 8) number of nods between the first male and female flower, and 9) days lapsed from the formation of the first male to the first female flower. Fruits were harvested at full maturity and transferred to the laboratory. Four fruits were randomly assigned from each plot to determine the following traits: 1) fruit weight (kg), 2) fruit length (cm), 3) fruit diameter (cm), 4) fruit flesh thickness (cm), 5) total soluble solids percentage (% TSS, measured by Brix refractometer), and 6) total yield (ton/feddan).

All recorded data were statistically analyzed (Gomez and Gomez, 1984) and treatment means were compared using the Duncan's multiple range test (DMRT) at 0.05 probability level.

RESULTS AND DISCUSSION

As shown in Tables 2 and 3, significant differences were found among pumpkin entries in both seasons for all studied vegetative and reproductive growth traits. Tables 3 and 4 present quantities of fruit yield and fruit characteristics of the 15 pumpkins studied entries during two seasons. Significant differences were found for all measurements.

Plants of 'Butternut' showed the shortest vine and produced the smallest number of leaves/plant. This cultivar was the earliest to form first male and female flowers and had the least number of nodes below the first male and female flowers. Further, it had the fewest number of nodes between the position of the first male and female flowers and the least number of days lapsed from the first male formation to the first female flower appearance. Clearly, the percentage of female to male flowers (sex ratio) characterized the 'Butternut' cultivar. The compact growth of 'Butternut' was accompanied by decreased fruit yield as it produced the lowest yields among all pumpkin entries. Fruits of 'Butternut' were the smallest in weight and diameter. The fruit flesh thickness was the least for 'Butternut' but it had the highest total soluble solids.

In contrast, 'Etamp' had the longest vine and developed the greatest number of leaves per plant in both seasons. This cultivar developed the greatest number of nodes before forming the first male and female flowers. The large vine of 'Etamp' plants has been well reflected in producing the highest fruit yield. Fruits of 'Etamp' were the heaviest, longest, the greatest in diameter and of larger fruit thickness.

Each local and regional accession was characterized by individual traits, mainly

inferior to ‘Etamp’ and ‘Butternut’. Khartoum accession (from Sudan) was the latest in emergence of the first male and female flowers. El-Mansura accession (from Egypt) was the lowest for sex ratio. The highest number of nodes between the first male and female flower was demonstrated by Pepa accession (from Egypt). The greatest number of days between the first male and female flower was recorded for Desuk accession (from Egypt). The shortest fruits were obtained by Omdurman accession (from Sudan). Bardeas (from Egypt) accession had the lowest total soluble solid of fruit juice.

Our investigation along with previous studies of local pumpkin landraces/ accessions (Damarany et al., 1995; Alsadon et al., 2002; Mostafa, 2006) seems to be in well agreement on the notion of needs for breeding efforts. Deterioration in crop productivity and fruit quality of these predominantly open pollinated species could be attributed to seed production by unaware local farmers (Hassan, 1991; Al-Sulaiman, 1992). Farmers are practicing negative selection as they usually save seeds from unmarketable fruits remaining at the end of harvest season on inferior plant segregates. However, landrace/accession germplasm may still be useful as they would possess adaptation to prevailing biotic and/or abiotic local complex environment. It would be advised then to breed via introgression of desirable traits of ‘Etamp’ and ‘Butternut’ into local landrace/accession genomes.

CONCLUSION

‘Etamp’ may directly be adopted in the production system in Sohag and other regions of similar conditions as a high yielding cultivar. Both ‘Etamp’ and ‘Butternut’ are nominated germplasm for breeding programs to improve productivity and quality of the studied Egypt local pumpkin accessions.

ACKNOWLEDGEMENT

The authors would like to thank Prof. Dr. Mohamed F.M. Abdallah (Department of Horticulture, Faculty of Agriculture, Assiut University, Assiut, 71526 Egypt) for proof reading and revising the manuscript.

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Tables

Table 1. Name, source and fruit characteristics of 15 pumpkin genotypes grown at Faculty of Agriculture, Sohag University, El-Kawser, Sohag, Egypt.

Genotypes	Source	Skin color	Flesh color	Fruit size	Fruit shape	Shell
El-Kola	Local, Sohag Egypt	Light yellow	Yellow	Large (>4 kg)	Pyriform-globular	Semi-grooved
Abu Tisht	Local Qena Egypt	Light orange	Yellow	Large (>4 kg)	Pyriform-globular	Semi-grooved
Bardis	Local, Sohag, Egypt	Green yellow	Light yellow	Large (>4 kg)	Pyriform	Smooth
Ismailia	Local, Ismailia, Egypt	Yellow	Orange	Large (>4 kg)	Pyriform-globular	Semi-grooved
Omdurman	Local Sudan	Dark green	Deep orange	Medium (2-4 kg)	Globular	Grooved
Khartoum	Local Sudan	Light green	Light yellow	Medium (2-4 kg)	Globular	Semi-grooved
Kom Badar	Local, Sohag, Egypt	Dark copper	Deep orange	Medium (2-4 kg)	Globular	Grooved
El-Edua	Local, El-Minia, Egypt	Yellow	Light yellow	Medium (2-4 kg)	Globular	Grooved
Etamp	USA cv*	Yellow	Light yellow	Large (>4 kg)	Pyriform	Semi-grooved
El-Mansura	Local, Mansoura Egypt	Light copper	Orange	Large (>4 kg)	Pyriform	Grooved
El-Kanater	Local, Kalubia, Egypt	Light yellow	Light yellow	Large (>4 kg)	Pyriform	Smooth
Butternut	USA cv*	Copper	Yellow	Small (<2 kg)	Pyriform	Smooth
Qus	Local, Qena, Egypt	Copper	Light orange	Small (<2 kg)	Pyriform	Semi-grooved
Pepa	Local, Beni Suef, Egypt	Copper	Light orange	Medium (2-4 kg)	Pyriform	Semi-grooved
Desuk	Local, Kafr El-Sheikh, Egypt	Copper	Light orange	Large (>4 kg)	Pyriform	Grooved

*Provided by A.M. El-Damarany, Faculty of Agriculture, Sohag University, Sohag, Egypt.

Table 2. Vine length, number of leaves/plant, sex ratio (%), days to the first male flower and nods to the first male flower for the 15 pumpkin genotypes sown during 2007 and 2008 seasons.

Genotypes	Vine length (cm)		Number of leaves per plant		Sex ratio (%)		Days to first male flower		Nods to the first male flower	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
El-Kola	4.69 h	4.68 i	169.0 hi	168.0 hi	6.73 ef	7.05 ef	54.00 cde	53.67 cd	5.33 de	5.67 bc
Abu Tisht	4.45 i	4.46 j	185.0 e	184.0 e	8.08 cd	7.82 bcde	53.00 def	52.67 de	6.33 abc	6.00 bc
Bardis	5.51 b	5.52 b	191.0 d	190.0 d	8.99 ab	8.61 ab	52.67 efg	52.33 ef	5.67 cde	6.00 bc
Ismailia	4.83 f	4.82 f	182.0 f	181.0 f	6.81 ef	7.17 def	56.00 b	55.67 b	5.67 cde	5.33 c
Omdurman	4.19 l	4.18 n	133.0 k	134.0 k	8.51 bc	8.08 bcd	57.67 a	57.33 a	5.67 cde	5.33 c
Khartoum	4.26 k	4.25 m	135.0 k	135.0 k	7.92 cd	7.52 cdef	58.00 a	57.67 a	6.33 abc	6.00 bc
Kom Badar	4.27 k	4.28 l	168.0 i	167.0 ij	7.64 d	7.90 bcde	51.67 fg	51.33 f	6.67 ab	6.33 b
El-Edua	4.70 h	4.71 h	176.0 g	177.0 g	7.61 d	7.32 cdef	54.33 cd	53.67 cd	5.67 cde	5.67 bc
Etamp	5.66 a	5.67 a	221.0 a	221.0 a	8.11 cd	7.76 bcde	51.33 g	51.67 ef	7.00 a	7.33 a
El-Mansura	4.88 e	4.88 e	199.0 c	200.0 c	6.54 f	6.79 f	52.33 fg	52.00 ef	5.67 cde	5.33 c
El-Kanater	4.76 g	4.75 g	165.0 j	165.0 j	7.88 cd	7.53 cdef	54.00 cde	53.67 cd	6.00 bcd	5.33 c
Butternut	3.35 m	3.35 o	128.0 l	127.0 l	9.70 a	9.41 a	45.33 h	45.00 g	4.33 f	4.00 d
Qus	4.99 d	5.00 d	205.0 b	206.0 b	7.88 cd	7.65 cdef	52.33 fg	52.67 de	5.33 de	5.33 c
Pepa	4.36 j	4.37 k	171.0 h	170.0 h	8.52 bc	8.15 bc	54.67 c	54.33 c	5.00 ef	5.33 c
Desuk	5.36 c	5.36 c	167.0 ij	166.0 ij	7.45 de	7.09 ef	52.00 fg	51.33 f	5.67 cde	5.33 c

Means for genotypes followed by the same letter (s) are not significantly different at the 5% probability level.

Table 3. Days to the first female flower, nodes to the first female flower, nodes between the first male and female flower, days lapsed from the first male formation to the first female flower formation and fruit weight (kg) for the 15 pumpkin genotypes sown during 2007 and 2008 seasons.

Genotypes	Days to the first female flower		Nodes to the first female flower		Nodes between the first male and the first female flower		Day lapsed from the first male formation to the first female flower formation		Fruit weight (kg)	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
El-Kola	58.00 cd	58.33 d	15.67 ef	15.33 fg	10.33 cd	9.67 c	4.00 bc	4.67 bcd	5.10 f	5.13 g
Abu Tisht	57.33 de	57.00 ef	17.00 bc	16.67 cd	10.67 bcd	10.67 abc	4.33 bc	4.33 cde	7.61 b	7.66 b
Bardis	56.33 efg	56.67 efg	16.00 def	15.67 efg	10.33 cd	9.67 c	3.67 bc	4.33 cde	7.18 c	7.23 c
Ismailia	61.00 b	61.33 b	16.67 bcd	16.33 cde	11.00 bc	11.00 ab	5.00 ab	5.67 bc	4.63 g	4.73 h
Omdurman	61.33 b	61.67 b	15.67 ef	15.33 fg	10.00 cd	10.00 bc	3.67 bc	4.33 cde	2.37 j	2.32 k
Khartoum	63.00 a	63.67 a	17.33 b	17.67 ab	11.00 bc	11.67 a	4.67 bc	6.00 ab	2.73 i	2.85 j
Kom Badar	55.00 g	55.33 i	17.00 bc	16.67 cd	10.33 cd	10.33 bc	3.33 bc	4.00 de	2.90 i	2.92 j
El-Edua	59.33 c	59.67 c	16.33 cde	16.00 def	10.67 bcd	10.33 bc	5.00ab	6.00 ab	3.76 h	3.72 i
Etamp	55.33 fg	55.67 hi	18.67 a	18.33 a	11.67 ab	11.00 ab	4.00 bc	4.00 de	9.80 a	9.90 a
El-Mansura	56.33 efg	56.67 efg	16.00 def	15.67 efg	10.33 cd	10.33 bc	4.00 bc	4.67 bcd	6.05 e	6.08 e
El-Kanater	56.33 efg	56.00 ghi	16.33 cde	16.00 def	10.33 cd	10.67 abc	2.33 c	2.33 f	5.23 f	5.31 f
Butternut	43.00 h	42.67 j	7.00 g	6.67 h	2.67 e	2.67 d	-2.33 c	-2.33 f	1.08 l	1.12 m
Qus	56.67 def	56.33 fgh	16.00 def	16.33 cde	10.67 bcd	11.00 ab	4.33 bc	3.67 def	1.60 k	1.60 l
Pepa	57.00 de	57.33 e	17.33 b	17.00 bc	12.33 a	11.67 a	2.33 c	3.00 ef	3.87 h	3.82 i
Desuk	59.00 c	58.67 d	15.33 f	15.00 g	9.67d	9.67 c	7.00 a	7.33 a	6.55 d	6.57 d

Means for genotypes followed by the same letter(s) are not significantly different at the 5% probability level.

Table 4. Fruit length (cm), fruit diameter (cm), fruit flesh thickness, TSS (%) and total yield (ton/feddan) for the 15 pumpkin genotypes sown during 2007 and 2008 seasons.

Genotypes	Fruit length (cm)		Fruit diameter (cm)		Fruit flesh thickness (cm)		TSS (%)		Total yield (ton/feddan)*	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
El-Kola	22.33 j	22.20 k	12.20 m	12.17 l	2.44 f	2.43 g	4.68 l	4.66 l	26.80 e	26.47 e
Abu Tisht	34.27 e	34.12 e	20.80 b	20.76 b	2.34 g	2.33 h	5.45 g	5.45 g	29.58 c	29.24 c
Bardis	41.40 b	41.30 b	20.13 c	20.10 c	3.75 c	3.73 d	4.51 m	4.49 m	30.50 b	30.17 bc
Ismailia	22.70 ij	22.89 j	17.10 i	17.00 h	2.41 fg	2.38 g	5.82 f	5.83 f	26.64 e	26.31 e
Omdurman	13.16 m	13.10 n	17.72 h	17.52 g	2.15 i	2.14 j	5.18 j	5.17 j	13.93 k	13.67 k
Khartoum	20.20 k	20.18 l	14.45 l	14.35 k	2.12 i	2.13 j	5.05 k	5.06 k	14.73 j	14.77 j
Kom Badar	19.00 l	18.83 m	15.13 k	15.08 j	2.13 i	2.12 j	5.27 i	5.26 i	20.01 h	19.68 h
El-Edua	23.36 i	23.30 j	18.11 gh	18.11 f	2.25 d	2.24 i	6.42 b	6.42 b	18.11 i	18.44 i
Etamp	51.25 a	51.14 a	28.23 a	28.20 a	4.15 a	4.17 a	4.69 l	4.67 l	39.49 a	39.61 a
El-Mansura	39.03 d	39.37 d	16.25 j	16.22 i	3.97 b	3.96 c	6.21 c	6.22 c	23.41 f	23.45 f
El-Kanater	40.20 c	40.13 c	19.36 d	19.30 d	3.35 d	3.34 e	5.18 j	5.19 j	21.74 g	21.41 g
Butternut	24.30 h	24.37 i	12.09 m	12.14 l	1.95 j	1.94 k	6.68 a	6.67 a	5.183 l	4.85 l
Qus	25.10 h	25.03 h	18.30 fg	18.27 ef	3.25 e	3.24 f	5.95 e	5.96 e	30.65 b	30.31 b
Pepa	31.50 f	31.27 f	18.70 ef	18.67 e	4.12 a	4.13 ab	5.35 h	5.35 h	14.13 jk	13.80 k
Desuk	29.33 g	29.20 g	19.03 de	19.15 d	4.11 a	4.10 b	6.17 d	6.18 d	28.51 d	28.18 d

*Feddan is 4200 m^2, approximately 0.42 ha. Means for genotypes followed by the same letter(s) are not significantly different at the 5% level.

Figures

Fig. 1. Fruit characteristics of 15 pumpkin genotypes grown at Sohag, Egypt. **1:** El-Kola, Sohag; **2:** Abu Tisht, Qena; **3:** Bardis, Sohag; **4:** Ismailia; **5:** Omdurman, Sudan; **6:** Khartoum, Sudan; **7:** Kom Badar, Sohag; **8:** El-Edua, El-Menia; **9:** Etamp, USA cv.; **10:** El-Mansura; **11:** El-Kanater, Kalubia; **12:** Butternut, USA cv.; **13:** Qus, Qena; **14:** Pepa, Beni Suef; and **15:** Desuk, Kafr El-Sheikh. The bar is 22 cm.