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# EVALUATION OF FRUIT AND SEED YIELD AS WELL AS POSTHARVEST QUALITY OF SOME NEW GENOTYPES OF OKRA [*Abelmoschus esculentus* (L.) MOENCH]

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## ABSTRACT

The present study was carried out during the two successive summer seasons of 2008 and 2009 at Sabahia Horticultural Research Station, Alexandria, Egypt. This investigation aimed to evaluate five genotypes of okra for their edible pods and seed yields as well as fruit post harvest quality. It was found that Alexandria 1 cultivar gave the highest mean values for edible pod length, number of early edible pods/plant, and total edible pod yield (kg/fed). Alexandria 2 cultivar had the highest mean values for early edible pod yield (kg/fed). Line 1 gave the highest mean values for number of mature pods/ plant; in addition, it was significantly equal to Alexandria 1 cultivar regarding pod length, and Alexandria 2 cultivar concerning weight of 100 seeds. Line2 exhibited the highest mean values for total number of edible pods/plant, number of seeds/pod, and total seed yield (kg/fed). Line 3 showed the highest mean values for edible pod weight, but, it gave the lowest percentage of dry matter in edible pods comparing with the other genotypes. Pod color of Alexandria 1 cultivar was light green. But, it was dark green in lines 1 and 3, and medium green in Alexandria 2 cultivar and line 2. The storage period had significant effects on all chemical traits of okra pods. Total carbohydrate percentage decreased as the period of storage was prolonged. Significant losses were incident after 3 and 6 days of storage. In addition, the significant difference was recorded after 3 days of storage regarding dry matter percentage, where it decreased in all genotypes except for line 2. Meanwhile, contents of crude fibers in okra pods increased as the period of storage was prolonged till 6 days then decreased after 9 days. Also, total crude protein content of okra pods increased as the period of storage was prolonged. Significant increase was incident after 9 days of storage.

## INTRODUCTION

There is a continuous need to improve the edible quality, fruit performance and yield of the vegetable crops including okra. It belongs to family Malvaceae and genus *Abelmoschus*. The genus *Abelmoschus* is Asiatic origin, but the ancestral home of cultigen *A*. *esculentus* is disputed: India, Ethiopia, West Africa and tropical Asia have been suggested (Sharma, 1993). Okra is multipurpose use crop, valued for its tender and delicious pods. In West Africa; leaves, buds and flowers of okra are, also, consumed. The dried seeds provide oil, protein, vegetable curd and a coffee additives or substitutes. Okra dry seeds are reported to contain 18-20% oil and 20-25% crude protein (Berry *et al*., 1988). Foliage can be used for biomass and the dried stems serve as a source of paper pulp or fuel (Marten, 1982). Fresh okra pods have a short post harvest life, being prone to physical and physiological changes that reduce quality (Singh *et al*., 1978). It should be in the market within few hours of harvest and shipped under refrigeration.

This investigation aimed to evaluate five genotypes of okra for their edible pods and seed yields, and edible pod characters and their postharvest quality.

## MATERIALS AND METHODS

**1. Horticultural evaluation**

The present study was carried out during the two successive seasons of 2008 and 2009 at Alexandria Horticultural Research Station, Alexandria, Egypt. Plant materials of this study consisted of five genotypes of okra. These genotypes were two varieties and three breeding lines of okra. The varieties were "Alexandria 1" and "Alexandria 2", whereas, the lines were originated from a breeding program, started in 1995 at the above-mentioned Research Station, Alexandria, Egypt (Abd-Allah and Mansour, 2005).

A randomized complete block design with three replicates was used. Seeds of okra were planted in a single row, 4m long, 0.7 m wide and hills 30 cm apart at the rate of 4 seeds per hill. Each plot contained 5 rows for yield of edible pods and 5 rows for seed yield. The plot area was 28 $m^2$ for each. Sowing date was on the first of May. Three weeks later, seedlings were thinned and the strongest one was being remained in each hill. Other cultural practices were carried out as recommended in okra planting. Harvesting took place during the period from mid of June up to mid of September.

**Recorded measurements**

**a) Edible pod characters**

Edible pods were picked with all pedicels in the morning every 3 days. The following traits were recorded, as an average data of 50 edible pods per plot; pod length and diameter (cm), weight (g). Pod dry matter % was measured as the average of three different pickings and expressed as dry weight / fresh weight x 100.

**b) Edible pods yield and its components**

Early yield of edible pods (Kg/fed) and number of pods/ plant was calculated as the first 5 pickings. Total edible yield (Kg/fed) and number of pods/ plant were taken for 25 pickings

**c) Seed yield and its components**

The following traits were recorded; number of mature pods/pant (average data of 20 plants/plot), Number of seeds/pod (average data of 50 mature pods / plot), total seed yield (Kg/fed, was calculated based on the plot area), and weight of 100 seeds (in gram).

**2. Storage procedures:**

Edible pods were sorted out after harvest, and the defected pods were discarded. Pods of each experimental unit (400 gram) were packed in low-density polyethylene bags and arranged in a factorial experiment in RCBD, i.e., 5 genotypes, 3 periods of storage with three replicates. Period of storage (Zero, 3, 6, and 9 days) was considered as the main-plot and the genotypes as subplots, in addition, at harvest time treatment as control. Thus, the bags were placed in the cold storehouse at 8 °C and 95% relative humidity.

**Recorded measurements**

The following data were recorded at the end of each period of storage i.e., at three day-intervals; total carbohydrate content %, Crude fibers content

(mg /g dry matter), and Total crude protein content (mg /g dry matter) were carried out according to the A.O.A.C. (1995). Dry matter content % was measured as the average of samples of 50 grams each from shredded pods were placed in a hot air oven to dry up until constant dry weight.

**Statistical procedures**

The obtained data were statistically analyzed and tabulated and the differences were detected by the revised L.S.D at 0.05 level of probability according to Dospekhov (1984).

## RESULTS AND DISCUSSION

**1) Horticultural evaluation:**

**a) Edible pod characters**

Results given in Table 1 show that the Alexandria 1 cultivar and line 1 had the longest edible pods in both seasons. Meanwhile, Alexandria 2 cultivar gave the shortest edible pods in both seasons. On the other hand, the edible pods diameter of "Alexandria 2" cultivar and line 3 were thick comparing with those of Alexandria 1 cultivar which had thin pods in both seasons. Line 3 gave the lowest percentage of dry matter in edible pods comparing with the other genotypes in both seasons. Pod color of Alexandria 1 cultivar was light green. But, it was dark green in lines 1 and 3, and medium green in Alexandria 2 cultivar and line 2 in both seasons. With this respect, Abd-Allah and Mansour (2005) established new lines of okra to improve and meet the need of new cultivars of okra for fresh consumption.

**Table 1: Mean performance of the five okra genotypes with regard to edible pod characters in 2008 and 2009 seasons.**

| Okra genotypes | Pod length (cm) | Pod diameter (cm) | Dry weight (%) | Pod color |
|---|---|---|---|---|
| | | ***1st season*** | | |
| Alexandria 1 | 4.4 | 1.3 | 16.45 | Light green |
| Alexandria 2 | 3.3 | 1.8 | 16.84 | Medium green |
| Line 1 | 4.4 | 1.7 | 16.70 | Dark green |
| Line 2 | 3.8 | 1.6 | 16.26 | Medium green |
| Line 3 | 3.9 | 1.9 | 15.00 | Dark green |
| LSD at 0.05 | 0.17 | 0.19 | 1.008 | |
| | | ***2nd season*** | | |
| Alexandria 1 | 4.4 | 1.3 | 16.45 | Light green |
| Alexandria 2 | 3.3 | 1.8 | 16.30 | Medium green |
| Line 1 | 4.4 | 1.5 | 16.07 | Dark green |
| Line 2 | 3.9 | 1.5 | 15.84 | Medium green |
| Line 3 | 3.9 | 1.9 | 14.37 | Dark green |
| LSD at 0.05 | 0.14 | 0.15 | 1.304 | |

**b) Edible pods yield and its components**

Data in Table 2 exhibited that Alexandria 1 cultivar gave the earliest yield in number of edible pods/plant and the highest total edible pods/fed in both seasons, and the highest number of edible pods/plant in the second season. However, Alexandria 1 cultivar and line 3 did not differ significantly

regarding the number of early edible pods/plant in both seasons. In addition, line 3 gave the highest mean value of edible pod weight in both seasons**.** On the other hand, Alexandria 2 cultivar had the earliest yield of edible pods/fed in both seasons. Meanwhile, the highest total number of edible pods/plant was obtained by line 2 in both seasons, and Alexandria 1 cultivar in the second season. Similar results were obtained by Wafaa et al. (2007) regarding the same genotypes under this study.

**Table 2: Mean performance of the five okra genotypes with regard to edible pods yield and its components in 2008 and 2009 seasons.**

| Okra genotypes | Edible pod weight (g) | Early yield | | Total yield | |
|---|---|---|---|---|---|
| | | No. edible pod/plant | Edible pod yield (Kg/fed) | No. edible pod/plant | Edible pod yield (Kg/fed) |
| | | *1st season* | | | |
| Alexandria 1 | 4.03 | 8.4 | 25.6 | 80.9 | 5843.5 |
| Alexandria 2 | 3.93 | 6.1 | 30.4 | 60.2 | 4420.7 |
| Line 1 | 4.37 | 6.0 | 22.8 | 60.1 | 4816.8 |
| Line 2 | 3.63 | 6.1 | 21.8 | 84.3 | 5508.7 |
| Line 3 | 5.30 | 7.4 | 27.8 | 49.4 | 5016.8 |
| LSD at 0.05 | 0.290 | 1.55 | 2.05 | 1.32 | 106.62 |
| | | *2nd season* | | | |
| Alexandria 1 | 3.83 | 8.0 | 24.2 | 82.2 | 5904.0 |
| Alexandria 2 | 3.97 | 7.1 | 31.3 | 59.3 | 4315.7 |
| Line 1 | 4.37 | 7.0 | 23.3 | 59.6 | 4748.2 |
| Line 2 | 3.60 | 6.5 | 21.7 | 83.4 | 5562.4 |
| Line 3 | 5.80 | 7.7 | 29.0 | 48.7 | 5062.9 |
| LSD at 0.05 | 0.308 | 0.43 | 1.31 | 1.45 | 129.38 |

**c) Seed yield and its components**

Line 2 gave the highest mean values with regard to seed yield and its components in both seasons except for weight of 100 seeds in both seasons and No. of mature pods/plant in the second season (Table 3). Lines 1 and 2 did not differ significantly regarding number of mature pods/plant in the first season. The highest weight of 100 seeds was obtained by Alexandria 2 cultivar and line 1 in both seasons. Abdallah (2000) studied seven genotypes of okra and stated that there were significant differences among the studied genotypes concerning seed yield and its components.

**2) Storage effects**

**a) Total carbohydrate percentage**

Total carbohydrate percentage of okra pods decreased as the period of storage was prolonged (Table 4). Significant losses were incident after 3 and 6 days of storage. This finding may be due to leaching out of some of the constituents into the blanching medium. The previous observations are in agreement with those found by Inyang and Ike (1998) and Wafaa et al. (2007).

**Table 3: Mean performance of the five okra genotypes with regard to seed yield and its components in 2008 and 2009 seasons.**

| Okra genotypes | No. of mature pods/plant | No. of seeds/pod | weight of 100 seeds (g) | Total seeds yield (kg/Plot) |
|---|---|---|---|---|
| | | *1st season* | | |
| Alexandria 1 | 18.8 | 82.8 | 4.69 | 5.020 |
| Alexandria 2 | 18.3 | 74.4 | 5.07 | 4.377 |
| Line 1 | 23.3 | 80.1 | 5.37 | 5.100 |
| Line 2 | 22.3 | 86.4 | 4.56 | 5.787 |
| Line 3 | 15.5 | 75.4 | 4.64 | 4.503 |
| LSD at 0.05 | 1.92 | 1.66 | 0.518 | 0.5404 |
| | | *2nd season* | | |
| Alexandria 1 | 19.1 | 83.2 | 4.71 | 5.003 |
| Alexandria 2 | 18.4 | 74.7 | 4.85 | 4.483 |
| Line 1 | 23.7 | 81.8 | 4.99 | 4.907 |
| Line 2 | 22.0 | 86.3 | 4.48 | 5.177 |
| Line 3 | 15.5 | 76.5 | 4.59 | 4.587 |
| LSD at 0.05 | 1.58 | 1.63 | 0.263 | 0.1058 |

The different genotypes of okra showed significant differences in their total carbohydrate content. Alexandria 2 cultivar and lines 1and 3 had the significantly highest carbohydrate content. The five genotypes significantly varied in their response to the effect of storage period concerning total carbohydrate percentage of edible pod. In this regard Wafaa et al. (2007) studied the effects of freezing process and storage conditions on the characteristics of five genotypes of okra. They found that Alexandria 1 cultivar had the highest carbohydrates content followed by Alexandria 2. On the other hand, line 1 was found to have the lowest carbohydrate content.

**Table 4: Total carbohydrate percentage of the five okra genotypes, as influenced by period of storage.**

| Okra genotypes | Storage period (days) | | | | Genotypes mean |
|---|---|---|---|---|---|
| | At harvest | 3 | 6 | 9 | |
| Alexandria 1 | 25.05 | 26.39 | 10.31 | 13.21 | 18.74 |
| Alexandria 2 | 28.38 | 31.82 | 17.03 | 12.93 | 22.54 |
| Line 1 | 27.37 | 30.09 | 12.38 | 14.37 | 21.05 |
| Line 2 | 29.56 | 21.31 | 14.37 | 14.73 | 19.99 |
| Line 3 | 24.28 | 21.80 | 20.40 | 17.36 | 20.96 |
| Period mean | 27.12 | 24.92 | 15.87 | 14.39 | |
| LSD at 0.05 | | | | | |
| Genotypes (G) | 2.13 | | | | |
| Period (P) | 1.74 | | | | |
| G × P | 4.27 | | | | |

**b) Dry matter percentage**

Dry matter percentage of okra pods significantly decreased after 3 days of storage (Table 5). Such result could be referred to total carbohydrate losses from the pods during storage (Table 4). Edible okra pods of all genotypes did not differ significantly in between except in case of line 2 which had the lowest percentage of dry matter. The response of the studied genotypes were significant different during storage period regarding dry matter percentage of edible pod, as it increased in all genotypes except for line 2. This result is in accordance with those reported by Soliman (1999) and Wafaa et al. (2007) on edible pods of okra.

**Table 5: Pod dry matter percentage of the five okra genotypes, as influenced by period of storage.**

| Okra genotypes | Storage period (days) | | | | Genotypes mean |
|---|---|---|---|---|---|
| | At harvest | 3 | 6 | 9 | |
| Alexandria 1 | 12.00 | 11.25 | 11.43 | 10.80 | 11.37 |
| Alexandria 2 | 11.90 | 11.30 | 11.53 | 11.60 | 11.58 |
| Line 1 | 12.53 | 11.40 | 11.50 | 11.00 | 11.61 |
| Line 2 | 11.70 | 11.50 | 10.50 | 11.10 | 11.23 |
| Line 3 | 12.27 | 11.44 | 11.27 | 11.40 | 11.60 |
| Period mean | 12.09 | 11.50 | 11.31 | 11.30 | |
| LSD at 0.05 | | | | | |
| Genotypes (G) | 0.32 | | | | |
| Period (P) | 0.26 | | | | |
| G × P | 0.64 | | | | |

**c) Crude fibers content (mg /g dry matter)**

Data in Table 6 exhibited that crude fibers content of okra pods increased as the period of storage was prolonged till 6 days then decreased after 9 days. This finding is disaccording with Wafaa et al. (2007) who found that freezing procedure had no effect on crude fiber content. This result may be due to the insolubility of this component in water.

**Table 6: Crude fibers content (mg /g dry matter) of the five okra genotypes, as influenced by period of storage.**

| Okra genotypes | Storage period (days) | | | | Genotypes mean |
|---|---|---|---|---|---|
| | At harvest | 3 | 6 | 9 | |
| Alexandria 1 | 85.00 | 101.67 | 81.67 | 90.00 | 88.34 |
| Alexandria 2 | 81.67 | 95.00 | 90.00 | 95.00 | 90.42 |
| Line 1 | 86.67 | 103.33 | 131.67 | 86.67 | 102.09 |
| Line 2 | 91.67 | 83.33 | 126.67 | 68.33 | 92.50 |
| Line 3 | 83.33 | 78.33 | 96.67 | 111.67 | 92.50 |
| Period mean | 87.22 | 93.06 | 110.28 | 91.67 | |
| LSD at 0.05 | | | | | |
| Genotypes (G) | ns | | | | |
| Period (P) | 11.52 | | | | |
| G × P | 28.22 | | | | |

Edible okra pods of all genotypes did not differ significantly in between in their contents of crude fibers. The five genotypes differed significantly in their response to storage period concerning crude fibers content of edible

pod. In this regard, genotypes examined by Makhadmeh and Ereifej (2004) showed a wide range of crude fiber content. The increasing in Fiber content in okra fruit may be due to progress in age.

**d) Total crude protein content (mg /g dry matter)**

Total crude protein content of okra pods increased as the period of storage was prolonged (Table 7). Significant increase was incident after 9 days of storage. According to Inyang and Ike (1998) the blanching temperature may cause the coagulation, aggregation, and insolubilization of the proteins while other constituents were leached out thereby leading to increase it. In this regard, Wafaa *et al*. (2007) reported that protein content (on dry weight basis) increased, slightly, at zero time of storage.

Edible okra pods of all genotypes did not differ significantly in between in their contents of crude protein. The interactions between the tested genotypes and storage period were significant. In this regard, highly significant differences were shown in crude protein content among the five studied okra genotypes (Wafaa *et al.*, 2007).

**Table 7: Total crude protein content (mg /g dry matter) of the five okra genotypes, as influenced by period of storage.**

| Okra genotypes | Storage period (days) | | | | Genotypes mean |
|---|---|---|---|---|---|
| | At harvest | 3 | 6 | 9 | |
| Alexandria 1 | 34.00 | 50.71 | 62.98 | 77.88 | 56.39 |
| Alexandria 2 | 28.15 | 69.85 | 61.04 | 79.65 | 59.67 |
| Line 1 | 29.59 | 65.13 | 69.96 | 77.13 | 60.45 |
| Line 2 | 29.46 | 61.88 | 60.10 | 71.46 | 55.73 |
| Line 3 | 30.09 | 73.96 | 47.23 | 77.31 | 57.15 |
| Period mean | 29.54 | 65.48 | 59.24 | 75.70 | |
| LSD at 0.05 | | | | | |
| Genotypes (G) | ns | | | | |
| Period (P) | 5.51 | | | | |
| G × P | 13.49 | | | | |

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## تقييم المحصول الثمرى والبذرى وجودة الثمار فى مرحلة ما بعد الحصاد لبعض التراكيب الوراثية الجديدة للباميا

**سامح عبد المنعم محمد عبد الله ، محمد حامد طلبه و خليل على سليمان**
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أجريت هذه الدراسة خلال الموسمين الصيفيين لعامى ٢٠٠٨ و ٢٠٠٩ بمحطة بحوث البساتين بالصبحية ، الإسكندرية ، مصر. وكان الهدف من هذا البحث هو تقييم المحصول الثمرى والبذرى لخمسة تراكيب وراثية من الباميا ، وكذلك جودة الثمار فى مرحلة ما بعد الحصاد.

وجد أن الصنف اسكندرية ١ أعطى أعلى متوسطات قيم لصفات طول القرن القابل للأكل ، وعدد القرون المبكرة / النبات ، ومحصول القرون الكلى للفدان. كما أن الصنف اسكندرية ٢ تميز بأعلى محصول قرون مبكر / الفدان ،أما السلالة ١ فقد تميزت بأكبر عدد من القرون الناضجة للنبات، بالإضافة إلى أنها كانت مساويا معنويا للصنف اسكندرية ١ فيما يخص طول القرن القابل للأكل , وللصنف اسكندرية ٢ بالنسبة لوزن ١٠٠ بذرة. أما السلالة ٢ فقد أظهرت أعلى القيم لصفات العدد الكلى للقرون القابلة للأكل/نبات، وعدد البذور/ القرن، ومحصول البذور / الفدان. وأخيرا أعطت السلالة ٣ أعلى وزن قرن قابل للأكل إلا أن نسبة المادة الجافة كانت الأقل مقارنة بالتراكيب الوراثية الأخرى . أما من حيث لون القرون فقد كان لون القرن فى الصنف اسكندرية ١ أخضر فاتح ، واخضر متوسط فى الصنف اسكندرية ٢ والسلالة ٢ ، وأخضر داكن فى السلالتين ١ ، ٣ .

أما بخصوص فترات التخزين فقد أثرت تأثيرا معنويا على كل الخصائص الكيماوية لقرون الباميا. حيث وجد أن نسبة الكربوهيدرات الكلية تناقصت بإطالة فترة التخزين ؛ حيث كان الفقد معنويا بعد فترة تخزين ٣ ، ٦ أيام. كذلك فان نسبة المادة الجافة فى القرون نقصت معنويا بعد ٣ أيام من التخزين فى كل التراكيب الوراثية ما عدا السلالة ٢. أما محتوى القرون من الألياف الخام فانه زاد بإطالة فترة التخزين حتى ٦ أيام ثم حدث نقص معنوى بعد ٩ أيام. تشير النتائج المتحصل عليها ان محتوى القرون من البروتين قد زاد بإطالة فترة التخزين وكانت الزيادة معنوية بعد ٩ أيام من التخزين.

**قام بتحكيم البحث**

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