

HORTICULTURAL, FOOD STANDARDS AND SUSCEPTIBILITY TO INFESTATION WITH SOME INSECT PESTS FOR SOME NEW LINES OF OKRA [*Abelmoschus esculentus* (L.) Moench.]

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ABSTRACT

New seven lines of okra, which were cultivated at Sabahia Horticultural Research Station, were evaluated during 1998 and 1999 summer seasons for some horticultural traits, their susceptibility to infestation with two important insect pests and for some food properties. All the lines gave smooth and medium to dark green pods except line 3 that gave hard spiny pods and line 4 that had light green pods. Most of the lines flowered early, but line 4 was late in flowering. All the tested lines were susceptible to spiny bollworm *Earias insulana* Boisd., and cotton seed bug *Oxycarenus hyalinipennis* (casta) infestation. The percentage of infestation varied between 30.61 and 49.52% with *E. insulana* and from 7.23 to 20.62% with *O. hyalinipennis*. Line 3, (Fallahy x Eskandarani) was the least susceptible to infestation with the cottonseed bug and it could be considered almost tolerant to spiny bollworm while line 4, (Fallahy x Roomy) was the most susceptible to infestation with the two insect pests. The consumers in Cairo preferred Lines 2, 6 and 7 because they mainly prefer the medium to dark green pods, while the Alexandrine consumers preferred line 4 for its light green color and low mucilage content pods.

INTRODUCTION

Ten breeding lines of okra were released at Sabahia Horticultural Research Station (Ragheb *et al.*, 1995), which were originated throughout a breeding program started in 1990, (Ragheb, 1994). According to this investigation, four lines were rejected. The remainder six lines were subjected to additional four self-selected generations to get more homogeneity within these lines. An additional breeding line was added, so, the overall line number became seven lines.

Plants of okra are subjected to attack by great number of pests, which effect seriously the yield. Among these pests are the spiny bollworm, *Earias insulana* Boisd., and the cotton seed bug, *Oxycarenus hyalinipennis* (Costa). The infestation with spiny bollworm causes the blossom fail to open and the pods wholly or in part, are rendered worthless by the larvae which often feed into the seeds (Shehata 1965). This insect inhabited the green pods of okra at the end of the cotton season when the cotton boll surface become hard, as mentioned by Khidr *et al.* (1990). The cottonseed bug feeds on cotton and okra seeds (Gandi 1989) that lead to the decrease of germination percentage.

The present study was carried out to evaluate some horticultural traits, food standards and to search for tolerant new breeding lines of okra interrelation to their yield.

MATERIALS AND METHODS

The six breeding lines of okra, which were selected from the investigation of Ragheb *et. al.*, (1995) along with an additional line, were used in this trial. These lines were Roomy x Sedi Beshr (L1), Fallahy x Assiut (L2), Fallahy x Eskandarani (L3), Fallahy x Roomy (L4), Roomy x Eskandarani (L5) Assiut x Eskandarani x Assiut (L6) and Assiut x Sedi Beshr x Sedi Beshr (L7). They were developed by additional repeated self- selected four generations to insure more uniformity within the pedigree of each of them.

The seven breeding lines were grown in a randomized complete block design with three replications, at Sabahia Horticultural Research Station. The seed were sown on 15th of April in 1998 and 1999 summer seasons. Each entry was planted in 5 row- plot, 4 m long and 60 cm apart. The seeds were sown in hills spaced at 30 cm. After emergency the hills were thinned to one plant per hill. The common agricultural practices were practiced as recommended to get the superior fruit yield in each season, except 3 rows at each line, which were not treated with any insecticidal application for the purpose of insect studies.

I) Horticultural investigation:-

The following traits were taken out during the two experimental seasons of 1998 and 1999. Earliness was recorded as the days from sowing date to the opening of the first flower. Early yield/ plant (g), early number of pods/ plant, total yield/ plant (g) and total number of pods/ plant were taken on the inner 5 plants within each entry for 30 gatherings on three days anthesised picked pods. Pod net weight ratio was estimated as the average data of 50 fresh pods per plot. The next traits were recorded as an average from mature pods (6 days anthesised pods). They were mean pod weight (g), pod diameter (cm), length (cm), ridges number, spineless (scored from one to three which one denotes the smooth pod and three the spiny pod) and pod color that were visually determined by a score from one to three which one refers to light while three means the dark green pod. Mucilage (mg/100 g f.w) was measured as described by Woolf *et.al.*(1977). Dry matter % was determined as in the AOAC (1985). Plant height (cm) and number of branches / plant were taken at the end of the season.

II) Susceptibility of okra lines to some insect pests:

Examination of green pods started by the first week of July and continued at weekly intervals up to the end of the season during the fourth week of September in 1999 season only. Randomized samples of 30 green pods (edible stage) were collected from each plot, and 90 pods from each line were examined in the laboratory. Percentage of infestation with *E. insulana* for each replicate was calculated to as follows: % of infestation = No. of infested pods x100 /30. Each infested pod usually had from one to two larvae.

To estimate the percentage of infestation with *O. hyalinipennis*, samples of 20 dry pods from each plot were collected at random after being harvested at intervals of 2 weeks starting on the 15th of August till the end of September. The seeds were examined at laboratory and calculated the percentage of infestation using this equation: % of infestation = No. of infested seeds x100 /Total No. of seeds of 20 pods.

III) Food standard evaluation:

Food standard evaluation was done in 1999 season only on six lines because Fallahy x Eskandarani line had spiny pod, so, it was rejected.

- 1- Consumers evaluation of the fresh okra fruits was done by a random sample of eleven consumers at Sabahia Horticultural Research Station at Alexandria and seven consumers at Vegetable Research Department Hort. Res. Inst. at Cairo to detect the best lines from the point of view of these consumers. Color, spineless, appearance and general acceptance were scored from 1 to 5, which 1 is poor and 5 is excellent.
- 2- Organoleptic tests were done on the freshly cooked fruits of okra of the six studied lines to determine the preferred lines for cooked pod color, appearance, texture and taste. This was done at Alexandria as described by Damir (1973 and 1978). Each character was scored by a measure from 1 to 5 where 1 referred to the poor and 5 to the excellent case. Fruit preparation and cooking were done as described by Abo- EL-enen (1982). The recorded data were averaged and statistically analysed according to Dospekhov (1984).

RESULTS AND DISCUSSION

I- Horticultural investigation:-

The seven investigated lines of okra reached the significance level for all the studied traits in 1998, while pod net weight ratio and mucilage did not statistically differ in 1999, (Tables 1,2). Line 7 was the most earliest one over the two seasons (44.7 and 44.0 days at 1998 and 1999, respectively), while line 4 was the most latest which was flowered at 61.3 and 61.0 days after planting at the two subsequent seasons of study, respectively. Lines 1,2 and 7 gave the highest early pod yield/plant over the two seasons. But lines 1,6 and 7 exhibited the greatest total pod yield/ plant at 1998 and 1999 seasons. The highest pod weight was in line 3, whereas line 6 had the lowest value of this trait. Line 4 gave the most thin and tallest pods. The highest pod ridges number was in line 2. Most of the lines exhibited smooth pods except line 3, which gave hard spiny pods, while line 1 had barley smooth pods. The dark green pods were in line 2, while line 4 gave the lightest green pods. Lines 2 and 7 gave the tallest plants. Line 4 was the most branched line. In general, line 1 had green and medium tall plants with green and mostly smooth pods. Line 2 gave green, tall plants with dark green, clearly ridged, thick and smooth pods. Line 3 had red and somewhat short plants, medium green and spiny pods. Line 4 had green, medium tall plants, which gave thin, tall and light green pods. Line 5 exhibited green and somewhat tall plants, with thick, smooth and medium green colored pods. Line 6; the plants had tall and red stems, the pods were dark green and smooth. Line 7 had green and tall plants and the pods were dark green, thick and smooth.

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I- Susceptibility of okra breeding lines to the infestation with some insect pests:-

1) The spiny bollworm, *E. insulana*:

Data in Table (3) and Fig.(1) show that L.2 significantly was the most susceptible to the infestation with a mean percentage 49.52%. On the other hand L.1 significantly was the least susceptible to the infestation with *E. insulana* with a mean of 30.61%. All okra breeding lines were susceptible to infestation and injured with the spiny bollworm and could be arranged as follow L.2, 49.52%; L.4, 43.08%; L.5, 37.67 %; L.7, 36.55%; L.6, 33.57%; L.3, 31.91% and L.1, 30.61%.

Data also revealed that, there were significant differences in the percentage of infestation with *E. insulana* in all breeding lines due to the inspection tim.Regardung to L.2 the intial infestion started to appear during the first week of July and the peak of infestation occurred during the third week of August, then it began to decrease during September. For L.4 the first attack appeared during the second week of July and two peaks of abundance were observed; the first peak during the fourth week of August and the second peak during the fourth week of September. Concerning to L.5, the infestation was obvious during the second week of July and reached its peak during the third week of September. The infestation of L.7 began to appear during the first week of July then it increased gradually until reached its peak during the third week of August. The spiny bollworm infestation for L.6 line started to appear during the first week of July and reached its peak during the second week of September. Regarding to L.3 the infestation started during the first week of July. The peak of infestation for this breeding line occurred during the fourth week of September. The infestation of L.1 began to appear during the first week of July and increased gradually till reached its peak during the third week of August then decreased thereafter.

Table (3): Mean percentage of infestation with spiny bollworm *E. insulana* on the studied seven lines of okra, in 1999. Summer season.

Month	Week	Lines						
		L.1	L.2	L.3	L.4	L.5	L.6	L.7
July	1 st	1.85	5.72	10.0	0.00	0.00	2.27	1.62
	2 nd	0.00	2.88	1.67	5.55	1.02	2.21	1.57
	3 rd	1.35	8.92	37.08	3.13	0.00	6.69	2.38
	4 th	6.30	21.03	34.87	7.40	28.68	6.80	16.62
	Mean	2.38 C	9.64 C	20.90 C	4.02 C	7.43 C	4.49 C	5.55 C
August	1 st	15.73	48.55	34.55	25.00	39.42	19.28	38.55
	2 nd	60.27	95.50	36.50	44.17	44.02	42.65	56.25
	3 rd	74.25	97.25	28.83	47.80	43.02	58.27	62.32
	4 th	60.82	94.00	41.35	68.85	44.23	51.22	54.62
	Mean	52.77 A	83.83 A	35.31 B	46.45 B	42.67 B	42.85 B	52.93 A
September	1 st	49.00	68.64	29.03	49.12	61.53	56.85	55.78
	2 nd	23.00	55.61	34.13	76.10	62.90	69.58	39.63
	3 rd	38.68	46.55	42.13	93.77	68.85	28.92	57.80
	4 th	36.12	49.55	52.73	96.12	58.33	58.08	51.43
	Mean	36.70 B	55.09 B	39.51 A	78.78 A	62.90 A	53.36 A	51.16 B
Mean	30.61 g	49.52 d	31.91 f	43.08 b	37.67 c	33.57 e	36.55 d	

Means followed by the same letter are not significantly different at 5% level by L.S.D test.

2) The cottonseed bug *O. hyalinipennis*:

Data in Table (4) and Fig.(1) show the percentage of seed infestation with the cotton seed bug. Statistical analysis cleared that L.4 was significantly the most susceptible to the infestation with a mean of 20.62%, the same line was susceptible to the infestation with the spiny bollworm too. The least susceptible one to the infestation with the cotton seed bug was L.3 with a mean of 7.23% and none of the tested breeding lines was found to be free from infestation.

Data also indicated that the infestation with *O. hyalinipennis* in most tested breeding lines was higher in September than that of August. L.3 had a low infestation in both months.

Table (4): Mean percentage of infestation with cottonseed bug *O. hyalinipennis* on the studied seven lines of okra in 1999 season.

Month	Date	Lines						
		L.1	L.2	L.3	L.4	L.5	L.6	L.7
August	15 th	6.71	11.33	8.31	19.55	12.91	12.63	12.91
	30 th	10.52	10.61	8.09	18.91	6.79	10.08	10.62
	Mean	8.61 B	10.97 B	8.20 A	19.23 B	9.85 B	11.36 B	11.77 A
September	15 th	19.43	20.96	8.19	18.91	20.33	20.27	11.24
	30 th	17.76	23.11	4.31	25.11	18.81	26.35	11.39
	Mean	18.59 A	22.04 A	6.25 B	22.01 A	19.57 A	23.31 A	11.31 A
Mean	13.60 d	16.50 b	7.23 f	20.62 a	14.71 c	17.33 b	11.54 e	

Means followed by the same letter are not significantly different at 5% level by L.S.D test.

Table (5) Consumers evaluation for some pod characters of six studied lines of okra, done at Cairo and Alexandria, 1999.

Lines	Characters							
	Color		Spineless		Appearance		General acceptance	
	CC.	AC.	CC.	AC.	CC.	AC.	CC.	AC.
L.1	2.9	3.4	2.7	2.8	3.3	3.0	3.1	3.0
L.2	4.0	3.4	3.6	3.5	3.3	2.7	3.6	2.8
L.4	2.7	3.7	2.9	4.2	2.9	4.1	3.0	4.0
L.5	2.6	3.6	2.6	3.8	3.3	3.5	3.3	3.6
L.6	3.9	3.9	4.0	3.2	3.9	2.7	4.0	2.9
L.7	3.6	4.2	3.3	4.3	3.4	4.2	3.6	3.8
F value	5.253**	1.330	3.061*	4.213**	1.013	6.812**	1.108	4.143**
L.S.D. 0.01	1.079	N.S	-	1.100	N.S	0.892	N.S	1.072
L.S.D. 0.05	0.799	N.S	0.987	0.827	N.S	0.678	N.S	0.806

*, ** Significant and highly significant at 0.05 and 0.01 levels, respectively.

CC.= Cairo consume.

AC.= Alexandria.

Table (6): Organoliptic tests of the freshly cooked fruits of six studied lines of okra, done at Alexandria, 1999.

Lines	Characters			
	Color	Appearance	Texture	Taste
L.1	3.2	3.4	3.1	3.2
L.2	3.1	3.0	3.1	3.0
L.4	3.9	4.2	4.1	4.1
L.5	3.7	3.6	3.6	3.5
L.6	3.6	3.3	3.1	3.1
L.7	3.7	3.8	4.0	3.9
F value	1.192	3.060*	4.604**	2.369*
L.S.D. 0.01	N.S	--	0.817	--
L.S.D. 0.05	N.S	0.738	0.617	1.015

*, ** Significant and highly significant at 0.05 and 0.01 levels, respectively.

III- Food standard evaluation:-

1) Consumer evaluation for the fresh okra fruits:

This evaluation was done at both of Cairo and Alexandria, (Table 5). The differences among the studied lines were significant at Cairo for color and spineless, while it was insignificant for appearance and general acceptance. It was found that the consumers at Cairo prefer the fruits of L.2, L.6 and L.7 because they mainly prefer the dark green color pods (Tables1,2). Regarding Alexandria consumers, their evaluation differences did not reach the significance level for color, however the differences were significant for spineless, appearance and general acceptance. It was shown that they prefer the fruits of L.4 because of its light green pods, (Tables 1, 2).

2) Organoleptic tests for the freshly cooked okra fruits:

The differences among the studied lines of okra, that was done at Alexandria only, were significant for most of the sensory properties i.e. appearance, texture and taste, but, the color property did not reach the

significance level (Table, 6). The most acceptable line was L.4, it had highest scores, which were 3.9, 4.2, 4.1 and 4.1 for color, appearance, texture and taste, respectively. This may be due to the preference of the Alexandrine consumers to the light green, thin, smooth that having the low content of mucilage, pods which was found in L.4, (Tables 1,2). It worth to mention that L.2 had got the lowest acceptance regarding the various studied properties.

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تقييم الصفات البستانية لبعض سلالات الباميا الجديدة وقابليتها للاستهلاك ومدى حساسيتها للإصابة ببعض الآفات الحشرية
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تمت هذه الدراسة على سبعة طرز من الباميا مستنبطة حديثه بمحطة بحوث البساتين بالصباحية الإسكندرية حيث تم التقييم خلال موسمي 1998 ، 1999 . وقد أعطت جميع السلالات قرون ناعمة ذات لون متوسط إلى داكن الاخضرار فيما عدا السلالة رقم 3 التي أعطت قرون خشنه الملمس والسلالة رقم 4 التي أعطت قرون ذات لون اخضر فاتح. وكانت معظم السلالات مبكرة الأزهار فيما عدا السلالة رقم 4 التي كانت متأخرة الأزهار وقد تعرضت كل السلالات للإصابة بدودة اللوز الشوكية وبقة بذرة القطن حيث تراوحت نسبة الإصابة من 30.61% إلى 49.52% بدودة اللوز الشوكية ومن 7.23% إلى 20.62% ببقة بذرة القطن وكانت السلالة رقم 3 (فلاحى X اسكندراني) هي اقل حساسية للإصابة ببقة بذرة القطن ودودة اللوز الشوكية بينما السلالة رقم 4 (فلاحى X رومي) هي الاكثر حساسية للإصابة بالحشرتين. وقد فضل المستهلكون بالقاهرة الذين قاموا بالتقييم السلالات 2 ، 6 ، 7 حيث انهم يفضلون الباميا المتوسطة أو الداكنة الاخضرار بينما فضل المستهلكون بالإسكندرية السلالة 4 حيث أن الذوق الإسكندري يفضل الباميا فاتحه اللون ذات المحتوى المنخفض من المواد المخاطية.

Table (1) Horticultural traits of the seven studied breeding lines of okra tested in 1998 summer season.

Lines	Earliness (days)	Early yield/ plant (g)	Early No. of Pods Pl.	Total yield/ plantl. (g)	Total No. of Pods/ plant.	Pod net weight ratio	Mean Pod weight (g)	Pod dia- maeter (cm)	Pod length (cm)	Ridges	spineless	Pod color	Mucilage mg/ 100g (f.w.)	Dry Matter %	Plant height (cm)	No.of Branches /plant
L.1	47.7	22.1	4.3	167	35.6	69.3	47.6	3.5	10.0	6.7	1.2	1.5	5.9	11.9	196.7	6.1
L.2	46.3	19.5	3.6	136.6	22.9	68.8	52.7	3.4	11.2	10.0	1.0	3.0	5.0	11.0	251.3	2.8
L.3	47.3	13.8	2.9	137.5	24.3	74.2	66.6	3.8	11.3	7.4	2.5	2.0	3.7	11.5	140.7	3.8
L.4	61.3	5.9	1.1	131.7	25.3	75.6	44.3	2.5	12.9	7.7	1.0	1.0	3.6	11.0	143.7	8.5
L.5	47.0	6.1	1.9	128.8	22.3	68.7	53.2	3.6	9.8	6.6	1.0	2.2	6.0	11.0	173.3	6.0
L.6	46.0	15.7	3.4	213.9	42.0	71.4	33.6	3.2	7.5	7.1	1.0	2.5	4.8	10.6	170.0	7.2
L.7	44.7	24.9	4.4	158.9	26.6	68.7	42.1	3.4	7.5	7.4	1.0	2.8	4.2	11.3	257.7	4.3
F value	20.495**	17.322**	21.40**	12.465**	21.47**	4.51*	242.22**	10.31**	18.56**	40.41**	1964**	192.27**	38.74**	19.03**	106.589**	8.397**
L.S.D. 0.01	4.927	9.413	1.041	33.551	14.375	-	2.398	0.501	1.822	0.643	0.046	0.186	0.564	0.365	16.499	2.875
L.S.D. 0.05	3.575	6.831	0.756	24.346	10.431	4.287	1.766	0.363	1.322	0.473	0.034	0.137	0.415	0.265	12.147	2.047

*,** Significant and highly significant of 0.05 and 0.01 levels respectively.

Table (2): Horticultural traits of the seven studied breeding lines of okra tested in 1999 summer season.

Lines	Earliness (days)	Early yield/ plant (g)	Early No. of Pods Pl.	Total yield/ plant (g)	Total No. of Pods/ plant	Pod net weight ratio	Mean Pod weight (g)	Pod dia- maeter (cm)	Pod length (cm)	Ridges	spineless	Pod color	Mucilage mg/ 100g (f.w.)	Dry matter %	Plant height (cm)	No.of branches /plant
L.1	46.0	16.8	3.8	159.2	33.6	69.2	46.3	3.5	10.3	6.9	1.2	1.8	4.4	12.8	168.6	4.8
L.2	46.0	20.7	3.8	142.7	23.3	68.7	52.3	3.4	10.8	9.3	1.0	3.0	3.6	11.6	194.2	3.1
L.3	47.0	9.1	2.3	132.9	24.6	72.2	67.0	3.8	11.8	7.6	2.5	2.3	4.1	11.6	143.2	3.9
L.4	61.0	5.9	1.0	124.8	24.1	73.3	46.3	2.7	12.6	7.6	1.0	1.9	4.6	10.4	165.2	8.3
L.5	47.0	15.7	3.2	146.4	22.8	71.5	50.0	3.6	10.0	6.6	1.0	2.5	4.1	11.3	168.3	3.8
L.6	47.0	12.1	2.5	162.9	35.7	70.9	34.0	3.2	7.8	7.1	1.0	2.5	4.0	13.0	136.0	6.3
L.7	44.0	17.8	3.7	150.6	26.3	68.8	42.0	3.4	8.5	7.4	1.0	3.0	4.3	11.6	182.5	3.2
F value	26.884**	16.129**	10.765**	2.01*	5.639**	2.169	265.71**	13.76**	59.48**	20.43**	888.7**	22.06**	0.215N.S	6.11**	4.74**	18.219**
L.S.D. 0.01	3.958	15.257	1.210	-	6.933	N.S	2.241	0.358	0.792	0.764	0.066	0.398	N.S	1.487	42.131	1.731
L.S.D. 0.05	2.914	11.071	0.878	29.764	4.825	N.S	1.650	0.260	0.583	0.554	0.048	0.289	N.S	1.058	29.320	1.256

*,** Significant and highly significant of 0.05 and 0.01 levels respectively.