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IMPROVING THE PRODCTIVITY OF GURMA MELON (*Citrullus colocynthoides*) THROUGH INBREEDING AND SELECTION.

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ABSTRACT

Gurma melon is classified as a vegetable crop. For a long time, no attempts were made to improve its characteristics or to develop new varieties. In this respect, five inbred families of gurma melon in S_4 generation were selected in an earlier study through self-pollination and selection program for the commercial cultivar. In this investigation these families were selfed to obtain the S_5 and S_6 generations and consequently, they were developed as new inbred lines, and they were compared and evaluated with the commercial cultivar. The results showed that the ranges of all studied traits for all lines became smaller in the S_6 generation than those in the S_4 generation. At the same time, the means of the selected plants were changed every generation for all studied traits, *e.g.*, the means of seeds weight /fruit and 100-seed weight were increased. The results also indicated that most new lines were significantly increased in comparison with the commercial cultivar for number of fruits/plant, seeds weight/fruit, 100-seed weight, yield/plant and yield/fed., while the commercial cultivar had the highest values of plant fresh weight, stem length, number of branches/plant and fruit weight. Generally, the results showed that selection program was very efficient to give desirable new lines for gurma melon.

INTRODUCTION

Citrullus colocynthoides has been cultivated since the early times in Egypt where it is known as gurma melon. The economic importance of gurma melon has recently increased, because its production exceeds the domestic consumption, hence, Egypt became able to export large quantities of its seeds. Moreover, its importance is due to its tolerance to drought and salinity, so it is a good crop for the new reclaimed lands.

However, its production has been confined to one variety. The seeds of this locally cultivated variety usually are obtained from any ripening fruit with no references to the characteristics of the original seeds, fruits or plant. Then, seeds from different fruits are collected together and sold to growers for cultivation. As a result of cross-pollination the heterogeneity of plants and fruits of cultivar were increased. Moreover, there have been a broad range of variations among the genetic characteristics of each type of the segregated types, especially with respect to the quantity and quality of produced seeds.

Therefore, one of the major factors to increase the production with best quality is to introduce new varieties. Consequently, this investigation was carried out to develop new inbred lines through the pedigree selection program which was started in a previous study by the first investigator. The program of self-pollination and selection was continued in this study to obtain the S_6 generation of the five inbred lines which could be used as new

varieties or to be further used in another breeding programs to improve this crop.

Nevertheless, very little genetic studies have been conducted to improve gurma melon traits. Abd El-Rahman *et al.*(1995) started with 20 fruits collected from different gurma melon fields. They carried out three generations of inbreeding and selection, and selected 10 families. They found that selection and inbreeding were useful to improve gurma melon families. Two families were more homogenous in shape, color and achieved the highest production of seeds in comparison with the commercial cultivar.

On the contrary, several researches have been done on other cucurbits crops. In this respect, Hayes and Immer (1942) mentioned that self-pollination of squash caused an improvement and led to obtain new lines with desirable characteristics. Iftikhar Sarwar *et al.* (1975) evaluated some exotic varieties of muskmelon, and they mentioned that the variety " Hearty of Gold" had the largest number of leaves, branches and fruits per plant. Chhonkar *et al.*(1979) indicated that selection in muskmelon could be effective for stem length, shape index and fruit weight which positively correlated with yield. Halsey (1979) found that selfing for several generations ensured homogeneity for some traits in some lines of cantaloupe. Ezura *et al.*(1995) evaluated 31 selected lines of melon. They found that 15 lines showed greater fruit size than the original cultivar.

Inbreeding with selection was very sufficient in recovering desirable lines from pumpkin (Unander and Ranirez,1988; damarany, 1989), Agoor (El-Adl *et al.*,1991) and sweet melon (Kosba *et al.*,1997). El-Adl *et al.*(1996) on agoor and Abd El-Hadi *et al.*(2001) on sweet melon noticed that a decrease in ranges from S_3 to S_5 generation in the traits of new inbred lines was associated with an uniformity for fruit weight, thickness and yield per plant.

Ghaderi and Lower (1979), Helmy (1985) and Rubino and Wehner (1986) found that inbreeding of different species and varieties of cucurbits did not gave considerable depression on vegetative growth and yield traits.

Hayes *et al.*(2005) grew inbred and outcrossed *Cucurbita pepo* ssp *texana* plants and measured inbreeding depression for several male and female fitnees traits for four years in a row in adjacent fields at the same field station under the same cultivation. They found that the magnitude of inbreeding depression varied from 0.16 to 0.53 from year to year and that those traits which were most affected tended to vary with year.

MATERIALS AND METHODS

The genetic materials used in this investigation were five families in the S_4 generation, which were obtained from a previous research work conducted by Abd El-Rahman *et al.*(1995) by using a pedigree selection program on the commercial cultivar of gurma melon. This investigation was carried out at El-Baramoon Experimental Farm, Dakahlia Governorate during the period of 2002-2005 with two stages the first stage started from March 2002 until August 2004, while the second one during 2005 season as follows:

First stage:

In the growing seasons of 2002 and 2003, the five selected families were self-pollinated to obtain the seeds of S_5 and S_6 generations using a pedigree selection program. The breeding program was directed to increase seeds weight/fruit and 100-seed weight. The following traits were presented in selected individual plants:

1- Fruit weight. 2- Number of fruits/plant.
3- Seeds weight/fruit. 4- 100-seed weight.
5- Yield/plant.

During the summer season of 2004, each selected genotypes was planted in an isolated field in private farm at Mansoura district to allow open-pollination. Then, fruits of each strains were collected and seeds were extracted and mixed to form the new variety seeds.

Second stage:

The five selected lines were evaluated with the basic commercial cultivar at El-Baramoon Experimental Farm during the summer season of 2005.

Their seeds were sown on 20 March. The experimental design was a complete randomized blocks design with four replicates. Each experimental unit area was consisted of four ridges each of 5 m length and 1.5 m in width, and one plants per hill with 50 cm apart. The culture practices were done according to the general program of gurma melon cultivation.

At 60 days after planting, a random sample of six plants was taken from the two inner ridges of each experimental unit to determine the growth parameters (plant fresh weight, stem length, and number of branches/plant).

At the harvesting time, a random sample of 12 plants was taken from each experimental unit to study the following characters:

1- Fruit weight. 2- Number of fruits/plant.
3- Seeds weight/fruit. 4- 100-seed weight.
5- Seed yield/plant.

In addition, each plot was harvested and seed yield/fed. was determined.

Data on studied characters were recorded for an individual plants to determine the degree of homogeneity (coefficient of variance) in the five lines and the commercial cultivar.

The data were statistically analyzed according to Snedecor and Cochran (1982). Differences among means were compared using the least significant difference value (L.S.D.).

RESULTS AND DISCUSSION

First stage:

The results of the selection programs are recorded for five lines in Table1. This table represents the means and ranges for each generation of selection for one of the five lines. This table also show the improvements of the traits as a result of selection.

Table 1: The means (M) and ranges (R) of all studied traits for five inbred lines of gurma melon at S_4, S_5 and S_6 generations.

Traits / Lines			Fruit weight (g)	Number of fruits/ plant	Seeds weight/fruit (g)	100-seed weight (g)	Seed yield/plant (g)
1	S_4	M	610	2.75	28.18	13.63	76.20
		R	530 – 740	2 – 4	22.71 – 30.90	13.11 – 14.92	51.54 – 96.12
	S_5	M	582	2.58	29.06	13.92	73.91
		R	544 – 706	2 – 3	23.83 – 30.76	13.45 – 14.82	52.91 – 78.65
	S_6	M	568	2.50	29.55	14.08	72.90
		R	535 – 689	2 – 3	24.46 – 30.28	13.86 – 14.42	54.32 – 75.12
2	S_4	M	574	2.92	28.11	11.12	81.71
		R	383 – 614	2 – 4	22.15 – 32.40	9.71 – 12.66	53.48 -103.11
	S_5	M	550	2.81	28.93	11.47	80.22
		R	396 – 593	2 – 3	24.64 – 31.67	10.52 – 12.40	55.26 – 85.53
	S_6	M	538	2.75	29.28	11.64	79.50
		R	390 – 581	2 – 3	25.12 – 31.35	11.16 – 11.98	56.72 – 83.31
3	S_4	M	560	2.83	29.15	12.70	81.59
		R	520 – 690	2 – 4	25.13 – 32.35	12.20 – 13.56	55.84 -106.56
	S_5	M	538	2.75	29.76	12.81	80.82
		R	511 – 661	2 – 3	25.97 – 32.01	12.55 – 13.34	56.95 – 92.06
	S_6	M	527	2.67	29.97	12.90	78.97
		R	509 – 650	2 – 3	26.40 – 31.73	12.78 – 13.16	57.83 – 85.48
4	S_4	M	670	2.83	32.79	10.40	91.66
		R	351 – 875	2 – 4	20.60 – 38.40	9.23 – 11.73	58.11–110.53
	S_5	M	633	2.67	33.42	10.61	88.14
		R	375 – 818	2 – 3	22.41 – 37.63	9.71 – 11.54	59.97 – 90.69
	S_6	M	596	2.58	33.88	10.82	86.40
		R	398 – 772	2 – 3	24.41 – 36.26	10.21 – 11.34	60.68 – 89.77
5	S_4	M	759	2.75	27.83	9.84	75.41
		R	381 – 943	2 – 4	25.92 – 30.85	8.19 – 10.38	52.88 – 97.76
	S_5	M	700	2.67	28.37	9.90	74.20
		R	403 – 862	2-3	25.92 – 30.45	8.82 – 10.28	53.96 – 85.59
	S_6	M	665	2.58	28.68	9.98	72.19
		R	417 - 804	2 - 3	26.93 – 30.01	9.51 – 10.26	55.02 – 83.86

The means of selected lines (1,2,3,4 and 5) indicate that there has been a remarkable changes in all studied traits in S_6 generation compared to the same traits in S_4 generation. The means of seeds weight/fruit and 100-seed weight were increased, while the means of fruit weight, number of fruits/plant and seed yield/plant were decreased from S_4 to S_6 generation.

At the same time, the results show that the ranges of all studied traits for all selected lines became smaller in the S_6 generation than those in the S_4 generation.

This narrow ranges which were noticed in the S_6 generation indicated that all studied traits reached a certain degree of uniformity and less degree of variability due to inbreeding and direct selection.

Second stage:

Degree of homogeneity:

It is clear from the results in Table 2 that estimation of coefficient of variance (CV%) values in the breeding new lines for the studied traits revealed high homogeneity within plants of these lines. All lines were higher in homogeneity (CV%) than the commercial cultivar. The degree of

homogeneity (CV%) varied from lines to another in the same trait, and from trait to other one at the same line. Generally it can be suggested that, these new inbred lines are enough homogeneous, and can be considered as new lines.

Behavior of the new lines:

The results of the evaluation of the five selected lines with the basic commercial gurma melon type are shown in Table 3. It could be notice from this table that significant differences were found among the five selected lines with respect to all studied traits.

Concerning the studied vegetative traits, data in Table 3 show that the commercial cultivar gave the highest means in plant fresh weight, stem length, and number of branches/plant than the five selected lines, while the lines 4 and 5 gave the lowest values for vegetative traits.

It is evident from the data in Table 3 that most selected lines were better than the commercial cultivar for number of fruits/plant, seeds weight/fruit, 100-seed weight, seed yield/plant and seed yield/fed.. Lines 4, 3 and 2 produced the highest seed yield/ fed. 489, 480 and 474 kg/ fed. respectively. The superiority of these lines in the seed yield/fed. is due to the number of fruits/ plant and seeds weight/fruit. The commercial type gave the lowest seed yield/ fed. 409 kg/ fed..

Table 2: Estimation of coefficient of variance (CV%) values for studied vegetative and yield traits in the five selected lines and the commercial variety (control).

Lines Number	Vegetative traits			Yield traits				
	Plant fresh weight (g)	Stem length (cm)	No. branches/ plant	Fruit weight (g)	No. fruits/ plant	Seeds weight/ Fruit (g)	100-seed weight (g)	Seed yield/ plant (g)
Control	17.09	30.06	18.52	5.07	15.57	5.88	8.69	21.75
1	8.56	16.86	7.71	1.39	8.10	4.51	4.64	14.46
2	9.35	9.86	7.13	2.11	9.04	4.34	5.17	11.00
3	8.47	9.97	5.13	0.93	10.28	4.46	6.26	14.88
4	13.32	18.28	11.65	2.59	11.02	4.71	5.23	15.33
5	14.31	16.26	5.42	2.66	11.27	4.81	6.95	16.20

Table 3: The means of the five selected lines and the commercial variety (control) for all studied vegetative and yield traits in the summer season of 2005.

Lines Number	Vegetative traits			Yield traits					
	Plant fresh weight (g)	Stem length (cm)	No. branches/ plant	Fruit weight (g)	No. fruits/ plant	Seeds weight/ Fruit (g)	100-seed weight (g)	Seed yield/ plant (g)	Seed yield/ fed. (kg)
Control	730	220	4.36	789	2.64	29.16	11.41	77.82	409
1	642	175	3.86	620	2.72	30.28	14.15	82.17	432
2	668	183	3.95	591	2.95	30.81	12.53	89.91	474
3	642	189	3.75	577	2.89	31.91	13.61	91.42	480
4	615	181	3.64	660	2.70	34.89	11.91	93.14	489
5	602	197	3.83	724	2.80	30.16	11.09	83.17	438
L.S.D.									
0.05	47.71	22.63	0.176	60.93	0.12	1.198	1.151	3.88	18.53
0.01	213.84	101.43	0.790	273.06	0.53	5.371	5.160	17.41	83.03

CONCLUSION

In general, the results of the present study indicated that inbreeding and selection were efficient to improve yield and quality characters. Then, these lines can be either used as a new cultivars of gurma melon or they can be used for further breeding programs to produce hybrids. These hybrids will be expected to be higher than their parents and the commercial cultivar.

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تحسين إنتاجية بطيخ اللب (الجورمة) بإستخدام التربية الداخلية و الإنتخاب

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يعتبر بطيخ اللب (الجورمة) أحد محاصيل الخضر في مصر. ولم تكن هناك محاولات لتحسين مواصفاته أو لإستنباط أصناف جيدة منه. و لهذا تم في هذه الدراسة إستخدام خمسة سلالات من بطيخ الجورمة تم إنتاجها من خلال برنامج إنتخابي سابق مع التلقيح الذاتي حتى الجيل الرابع للصنف التجاري المفتوح التلقيح. تم تطوير هذه السلالات في الدراسة الحالية إلى سلالات نقية من خلال الإستمرار في الإنتخاب و التلقيح الذاتي حتى الجيل السادس. ثم تمت مقارنتها مع الصنف التجاري.

أظهرت النتائج تناقص المدى لجميع الصفات في كل السلالات من الجيل الرابع إلى الجيل السادس، وفي نفس الوقت تغيرت متوسطات كل الصفات للنباتات المنتخبة في كل دورة إنتخاب فعلى سبيل المثال زاد متوسط كل من وزن البذور في الثمرة ووزن ١٠٠ بذرة.

كذلك أظهرت النتائج أيضا أن معظم السلالات تفوقت في صفات عدد الثمار للنبات، ووزن البذور في الثمرة، ووزن ١٠٠ بذرة، ومحصول البذور/نبات، ومحصول البذور/فدان مقارنة بالصنف التجاري الذي تفوق عن السلالات في صفات وزن الثمرة، والوزن الطازج للنبات، وطول الساق، وعدد الأفرع/نبات.

بصفة عامة، أظهرت النتائج فاعلية الانتخاب والتربية الداخلية في الحصول على سلالات مرغوبة من بطيخ اللب (الجورمة).