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The Possibility of Using the F_2 Seeds for Cucumber Production Under Plastic Houses

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Abstract. During two winter seasons, i.e., 1988/1989 and 1989/1990 both the F_1 and its F_2 plants of the cucumber cv "Katia K 2744" were evaluated under unheated plastic-houses at the Farm of the Aluminum Company of Egypt, Nag Hammadi, Upper Egypt.

There was no significant difference between the F_1 and F_2 in the seed germination percentage and the date of flowering of the plants.

In both seasons of study, the F_1 and the F_2 plants did not significantly differ in respect of total marketable yield, however, the F_1 plants significantly surpassed the F_2 in the early yield. In respect of fruit quality (weight, length, shape index and color), both F_1 and F_2 plants did not significantly differ.

Introduction

Parthenocarpic cucumber varieties have been grown as a greenhouse crop for many years. The inheritance of parthenocarpy in cucumber is controlled by an incomplete dominant gene P. In the homozygous condition (PP) produces early parthenocarpic fruits. Heterozygous (Pp) plants produce a fewer number of parthenocarpic fruits later than homozygous plants. The homozygous recessive (pp) produces no parthenocarpic fruits [1].

There is general beleif that in cucurbitaceae species, reduction in vigor and changes in quantitative traits do not result from inbreeding [2-5]. Inbreeding depression in cucumber and the nature of the heterozygosis-performance relationship have received little attention [6]. Cucumber improvement employs a virtually unlimited array of breeding method. Selection of single-plant is commonly in segregating F_2, F_3 or backcross populations [7, p. 584] and desirable recombinations are frequently subjected to inbreeding to stabilize and true-up prospective new lines. Cucumber have been identified as a crop with limited genetic variability [8]. Populations derived from adapted breeding lines have been found to contain little genetic variability for yield [9].

In most of the Arabian countries, the F_1 seeds of cucumber are imported each year for commercial production under plastic-houses, consequently a lot of hard currency is used for this purpose. The aim of this work is to study the possibility of using the F_2 seeds in the commercial production of cucubmer under plastic-houses for saving the hard currency which is paid for importing the F_1 hybrid seeds.

Materials and Methods

Seeds of the F_1 hybrid of cucumber cv "Katia K 2744" obtained from Sluis and Groot Seed Co. (Holland) were sown directly on October 15, 1987 for commercial production under unheated plastic-houses at the Experimental Farm of Assiut University and the Farm of the Aluminum Company of Egypt, Nag Hammadi, Upper Egypt. Normal cultural practices as recommended for production in plastic-houses were followed.

At the flowering period, new male flowers were noticed on some plants which are supposedly carrying only female flowers. Hand self-pollinations were made on some of these plants. Pollinated fruits were left to maturity then F_2 seeds were extracted. The following data were recorded on the F_2 seeds:

1. Number of seeds per mature fruit: Both total and viable (fully filled) seeds found in each fruit were counted.
2. Percentage seed germination: Four replications, ten seeds each, from both the F_1 (Sluis and Groot Co.) and the locally extracted viable F_2 seeds were germinated in an incubator at 25°C and germination percentage was calculated.

During the two successive winter seasons of 1988/1989 and 1989/1990 seeds of the F_1 cucumber cv "Kita 2744" and its locally extracted F_2 were directly sown on October 22 in unheated plastic-house (8.5 m width, 60 m long and 3.85 m height, 510 m^2) located in the Farm of the Aluminum Company of Egypt, Nag Hammadi. Plants were distributed in a completely randomized block design with four replications. Each replicate consisted of 50 plants at 2.5 plants/m^2.

Data were recorded on the following traits:

1. Date of flowering (days): Number of days from sowing to flowering of 50% of the plants.

2. Percentage of plants that produced male flowers: Number of plants that produced any male flowers/Total number of plants × 100.

3. Average marketable fruit weight (g): Samples of randomly taken 10 fruits were weighed and average fruit weight was calculated.

4. Average marketable fruit length (cm): As in (3), average fruit length was estimated.

5. Fruit shape index: Fruit length/fruit diameter was determined.

6. Fruit color: It was estimated by subjectively rating the fruit color on a scale of 1 = very light green to 5 = uniformly dark green.

7. Early marketable fruit yield (kg/510 m^2): Weight of the marketable fruit that was harvested during the first 9 pickings.

8. Total fruit yield (kg/510 m^2): Total yield of fruits harvested over all harvesting period was recorded.

Data and transformed data for percentages were subjected to statistical analysis according to Snedecor and Cochran [10, 324-330]. The coefficient of variation (cv) was also calculated.

Results and Discussion

Numbers of F_2 seeds per mature fruit

As shown from Table 1, total number of F_2 seed/fruit ranged from 119 to 426 with an average of 249.3 seeds/fruit. However, the number of F_2 viable seeds/fruit ranged from 26 to 251 with an average of 131.1 seeds/fruit. Moreover, the percentage of viable seeds in the fruit ranged from 13.64 to 96.25 recording an average of 55.22%. The wide range in the number of viable seeds in the fruit may be due to the low efficiency of pollination. Therefore, increasing number of F_2 viable seeds could be obtained by more careful pollination and/or by maintaining suitable conditions for fertilization.

It is clear also from Table 1 that the viable F_2 seeds obtained from only 10 fruits were enough to plant one plastic-house.

Table 1. Number of locally extracted F_2 seeds (total and viable) pe fruit and percentage of viable seeds/fruit

Fruit no.	Seeds/fruit		% Viable seeds	Fruit no.	Seeds/fruit		% Viable seeds	Fruit no.	Seeds/fruit		% Viable seeds
	Total	Viable			Total	Viable			Total	Viable	
1	236	76	32.20	15	256	90	35.16	29	257	107	41.63
2	176	26	14.77	16	249	148	59.44	30	200	113	56.50
3	225	85	26.18	17	317	251	79.18	31	88	80	90.91
4	297	105	37.78	18	204	145	71.08	32	137	119	86.86
5	148	144	35.35	19	240	148	61.67	33	158	101	63.92
6	151	101	66.89	20	269	189	70.26	34	255	50	19.61
7	119	31	26.05	21	372	202	54.30	35	137	122	89.05
8	371	133	35.85	22	249	63	25.30	36	163	146	89.57
9	345	155	44.93	23	271	163	60.15	37	178	143	80.34
10	291	250	85.91	24	256	238	92.97	38	172	135	78.49
11	241	44	15.12	25	204	157	79.96	39	240	231	96.25
12	208	88	42.31	26	350	230	65.71	40	426	71	16.67
13	352	48	14.64	27	218	143	65.60	41	213	199	93.43
14	367	227	61.85	28	363	88	24.24	42	400	128	32.00

– Total number of fruits = 42

– Average number of F_2 seeds/fruits = 249.3

– Average number of viable seeds/fruit = 131.3

– Average percentage of viable seeds = 55.22

Percentage of seed germination

Data obtained on this trait (Table 2) indicated that the F_1 and F_2 seeds did not significantly differ from each other in the percentage of seed germination (100% and 98% in the F_1 and F_2 respectively). The low values recorded for cv (1.5 and 1.6 in the F_1 and F_2 respectively) represent the uniformity of germination for the viable F_2 seeds as well as the F_1. Moreover, high germination percentage for the F_2 seeds confirm the need for low number of self-pollinated fruits.

Date of flowering

Data on this trait are shown in Table 2. In both seasons of study, the F_1 and F_2 plants did not significantly differ from each other in the number of days from sowing to flowering of 50% of the plants. The uniformity of flowering of the F_1 plants is expressed in lower values for the cv % compared with those of the F_2.

Percentage of plants producing male flowers

Data presented in Table 2 indicate that about 2.5% of the F_1 plants produced male flowers, while about 6% of the F_2 plant had male flowers as an average of the two seasons of study. Cantliffe [11] and Lower *et al.* [12] showed that shorter days

Table 2. Percentage seed germination, date of flowering (days) and percentage plants that produced male flowers in both F_1 and F_2 cucumber

Generation	% Seed germin.	CV %	Date of flowering (days)	CV %	% Plants with flowers	CV %
			1988/1989 season			
F_1	100	1.5	31	3.8	3.0	2.8
F_2	98	1.6	28	8.8	8.0	5.2
LSD	N.S.		N.S.		3.7	
			1989/1990 season			
	F_1	–	–	33	3.2	2.0
2.0						
F_2	–	–	29	9.4	5.0	3.7
LSD			N.S.		2.1	

N.S. = nonsignificant at the 0.05 level.

and lower temperature promote increased female tendencies in cucumber. Conversely, high temperature and/or long days led to promote maleness. Moreover, they stated that with sufficient stresses, many genetically "gynoecious" cultivars will produce staminate flowers, sometimes abundantly. Also, previous report of Pike and Peterson [1] indicated that sex expression of gynoecious hybrids in cucumber that are heterozygous for gene involving in parthenocarpy is particularly subject to environment. In the present results, relatively high temperature and/or long days prevailing in Upper Egypt, e.g., Assiut and Nag Hammadi could be - in part - enhance male flowering in our materials.

Fruit length

As shown from Table 3, fruits of both F_1 and F_2 did not significantly differ from each other in the length of the marketable fruit. Previous work of Carlson [13] and Lower *et al.* [14] indicated that fruit length is a quantitative trait having intermediate (55%) estimate of narrow-sense heritability.

Fruit shape index

Data presented in Table 3 indicated that no significant difference was found between the F_1 and F_2 fruits in fruit shape index. This was true in both seasons of study. Generally, the ratio length/diameter is one of the quality attributes in cucumber with the values $\geqslant 4$ indicate thicker skinned fruits [7].

Fruit weight (g)

As presented in Table 3, fruits of the F_1 were heavier than those of the F_2. However, this decrease did not reach the significance level at the 5%. This was true in both seasons of study. These results are in the same line of Scott [3], Robinson and Whitaker [4] and Whitaker [5] who reported that changes in quantitative characters of cucurbitaceae might not be due to inbreeding. Moreover, slightly higher values for cv % of fruit weight was recorded in the F_2 as compared to those of the F_1.

Fruit color

Fruit color is an important attribute of fruit quality traits. Under the conditions of this work, fruits of both the F_1 and F_2 were classified as green (Table 3).

Early and total fruit yields (kg/house)

Data on the early and total fruit yields are shown in Table 3. In both seasons of study, it was found that the F_1 plants significantly surpassed the F_2 in the weight of the early yield. This could be due to the high yield of the early-flowering F_1 plants

Table 3. Yield and fruit quality of both F_1 and F_2 cucumber plants

Generation	Yield, kg/plastic house*				Fruit quality						
	Early	CV %	Total	CV %	Length (cm)	CV %	Shape index	CV %	Wt. (g)	CV %	Color**
					1988/1989 season						
F_1	200	7.2	2800	10.8	12.6	2.1	4.4	1.7	125.1	6,5	4
F_2	179	9.7	2700	12.4	13.2	2.8	4.1	1.8	124.0	8.4	4
LSD	18.7		N.S.		N.S.		N.S.		N.S.		
					1989/1990 season						
F_1	235	8.7	2830	9.9	12.9	1.9	4.3	1.8	127.0	6.8	4
F_2	185	9.0	2750	12.2	13.1	9.4	4.1	1.8	126.0	7.4	4
LSD	20.4		N.S.		N.S.		N.S.		N.S.		

* Plastic house about $510m^2$

** 1 = Very light green; 5 = uniformly dark green.

N.S. = nonsignificant at the 0.05 level.

which was indicated by its lower values of cv %. On the other hand, the total fruit yield of the F_2 was lower than that of the F_1. However, this reduction in the total yield was not significant at the 5% level. These findings could be confirmed by those of Scott [3], Robinson and Whitaker [4] and Whitaker [5] who indicated that inbreeding of cucurbitaceae could not result in great reduction in vigor.

From the promising results of this work, it could be worthy to produce the F_2 seeds on a large scale for the commercial production of cucumber under the plastic-houses. This could be practically done by artificially inducing male flowering on the gynoecious F_1 plants. The induction of male flowers on gynoecious cucumber was earlier reported by Peterson and Anhder [15], Pike and Peterson [16] and Den Nijs and Visser [17].

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إمكانية استخدام بذور الجيل الثاني للإنتاج التجاري من الخيار تحت الصوب البلاستيكية

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ملخص البحث. يستخدم عادة هجين الجيل الأول (F_1) للإنتاج التجاري للخيار تحت الصوب (البيوت) البلاستيكية. وحتى الآن تقوم مصر ومعظم الدول العربية الأخرى باستيراد هذه التقاوي سنويًا من الخارج مما يحتاج للكثير من العملة الصعبة.

ويهدف هذا البحث إلى دراسة إمكانية استخدام تقاوى الجيل الثاني (الرخيصة الثمن والسهلة الإنتاج محليًا) في الإنتاج التجاري للخيار تحت الصوب البلاستيكية بدلاً من بذور الجيل الأول.

خلال موسمى ١٩٨٨/١٩٨٩م، ١٩٨٩/١٩٩٠م تم زراعة كل من بذور الجيل الأول والجيل الثاني من صنف الخيار الهجين Katia K 2744 في الصوب البلاستيكية غير المدفأة.

ولقد كانت أهم النتائج ما يلي:

١ ـ لم تكن هناك فروق معنوية بين بذور الجيلين الأول والثاني من حيث النسبة المئوية لإنبات البذور وعدد الأيام اللازمة للإزهار.

٢ ـ لم يكن هناك اختلاف جوهري بين نباتات الجيلين الأول والثاني من حيث المحصول الكلي على الرغم من أن نباتات الجيل الأول تفوقت معنويًا على الجيل الثاني في المحصول المبكر.

٣ ـ لم يختلف الجيل الأول عن الجيل الثاني معنويًا في صفات جودة الثمرة مثل طول الثمرة، وزن الثمرة، شكل الثمرة ولونها.