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EFFECT OF SELECTION AND INBREEDING ON BULB FLESH COLOR IN THE ONION CULTIVAR GIZA 20

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ABSTRACT

This work was carried out at Shandaweel Experimental Station, Agricultural Research Center, Sohag Governorate, Egypt from 1994 to 1998 seasons to study the effect of two cycles of selection on flesh color of the onion variety Giza 20. Full and half sibs progenies had more white fleshed bulbs than parental selected whites immediately detected after cutting. This also occurred in progenies of white mother bulbs detected a week after cutting in the second selection cycle full sibs. Predicted genetic advance due to selection was more than realized in the progenies of white fleshed first cycle. Moreover, realized genetic advance due to selection for white-fleshed bulbs was less than predicted in the progenies of pinks and parental detected a week after cutting, (second cycle). Accordingly, it is practically possible to produce Giza 20 bulbs completely free from any pink color if two cycles of selection were conducted and arising plants selfed.

INTRODUCTION

Light minute pink blotches appear recurrently in the flesh of very few “Giza 20” onion bulbs, which is commercially undesired. Jones and Peterson (1952) in crosses between true breeding yellow Brazilian cultivar Pera Baie and three yellow cultivars of American origin found that all F1 bulbs were light red. F2’s separately and combined segregation of 9 light red to 7 yellow occurred. Jones and Mann (1963) indicated that when some recessive white cultivars are crossed, colored bulbs, i.e., light red and/or yellow, appear in F1 indicating complementary factors for yellow and light red bulb colors. El-Shafie and Davis (1967) showed that the inheritance of onion bulb color necessitates the assumption of the interaction of at least five major genes acting upon a biochemical pathway that lead to pigment formation. El-Shafie and Ahmed (1977) found that exposure to light led to flesh pigmentation in susceptible genotypes.

Gamie (2000) found that selfing of white fleshed bulbs of Giza 20 increased their incidence than in commercial Giza 20. Realized genetic advance was more than predicted in the three selected populations.

This investigation is aimed at studying the effect of inbreeding and recurrent selection on the development of bulbs free from pink flesh blotches in the cultivar Giza 20.

MATERIALS AND METHODS

The present study was carried out at Shandweel Research Station, Sohag Governorate from 1994 to 1998 Seasons where the soil is loam.

At the end of storage (November, 1994) 1000 apparently single white fleshed bulbs were halfway horizontally sectioned for a first cycle of selection.

Flesh of 545 bulbs was white and 455 was pink. Bulbs were separately planted for seed production under two lumite isolation cages. Interpollination was effected by honeybee insects entered during flowering with an umbel/plant bagged to produce full sibs (selfed progenies) and half sibs (progenies of plants open pollinated under the cage).

In May, 1995, seeds were mass collected to produce the full sibs and half sibs of the first selection cycle (C_1) from white and pink fleshed selections (cages). In September, 1995, seeds from full and half sibs white and pink fleshed cages and Giza 20 original commercial S_0 populations, were all sown in seed beds. In November, 1995, seedlings were transplanted in a randomized complete block design with three replications. Plot was 2x3 m. Transplants were spaced 7 cm apart on both sides of the ridge. Natural cultural practices for a bulb crop were adopted. Plants were harvested (pulled) and field cured for two weeks. Foliage was removed and bulbs were stored. By the end of storage period, in November, 1996, bulbs were half way horizontally sectioned for a second selection cycle (C_2). The following groups were separated from progenies of the white fleshed cage only.

1. 200 pink fleshed bulbs sorted out immediately after cutting.
2. 200 white fleshed bulbs detected immediately after cutting.
3. 120 white fleshed bulbs detected a week after cutting.
4. 280 pink fleshed bulbs detected a week after cutting.

These bulbs were separately planted in November, 1996 under four lumite isolation cages and left to interpollinate by honey bee insects entered during flowering. One seed stalk from each bulb was bagged (selfed). In May, 1997, seeds were collected to produce the C_2-full and half sibs of each cage. The 8 groups of seed, harvested in May, were sown in seed beds along with original Giza 20 commercial S0 in September, 1997.

In November, 1997, seedlings were transplanted in a randomized complete block design with four replications. All common bulb crop cultural practices were adopted. By the end of storage period, the following was recorded:

1. Percentage of bulbs with white flesh.
2. Percentage of bulbs with pink flesh.

All data were statistically analyzed using F-test. Means were compared using LSD and the coefficient of variability (cv%) was calculated according to Steel and Torrie (1982). Expected genetic advance was calculated according to Miller *et al*. (1958). The differences between predicted and realized genetic advance was calculated according to Pesek and Baker (1970).

RESULTS AND DISCUSSION

A. First selection cycle:

Means, percentages and coefficients of variability (cv%) of white and pink fleshed bulbs in the S1 original population whites and pinks selfed (full sibs) and bulked (half sibs) appear in Table (1).

Table 1: Mean percentage and coefficient of variability (cv%) of flesh color of Giza 20 onion in the progenies of white and pink fleshed population (first selection cycle 1995-1996).

Pedigree		White flesh			Pink flesh		
		Mean Number	%	C.V%	Mean number	%	C.V%
Progeny of pink flesh	Full sibs	127.48	63.74	18.27	72.52	36.26	12.54
	Half sibs	106.07	53.02	21.97	93.96	46.98	9.68
Progeny of white flesh	Full sibs	194.36	97.18	11.99	5.64	2.82	16.24
	Half sibs	172.30	86.15	13.52	27.70	13.85	22.83
So parent Giza 20	Full sibs	111.70	55.70	28.30	88.60	44.30	32.70
LSD 5%		35.06	16.05		12.53	11.05	
1%		NS	22.51		17.57	14.65	

cv%: Coefficient of variability.
NS: Not significant.

It is clear that percentage of white fleshed bulbs was highly significantly increased in full and half sibs of the progeny of white fleshed mother bulbs. They reached 97.18 and 86.15 in full and half sib, respectively. White fleshed bulbs were 55.70% in the original S1 population. Oppositely, percentage of pink fleshed bulbs were decreased in the progeny of white fleshed mother full or half sib bulbs. It was 44.30% in the original population and became 2.82% and 13.85% in the progeny of white fleshed full or half sibs, respectively.

Table 2: Predicted and realized genetic advance due to selection for white flesh color of Giza 20 onion cultivar in the progenies of pink and white flesh color populations (first selection cycle 1995/96).

genotypes		Predicted		Realized		Differences#	
		Full Sibs	Half sibs	Full sibs	Half sibs	Full sibs	Half sibs
Progeny of pink flesh	Mean	126.89	105.27	127.48	106.04	-0.59	-0.77
	Percentage	64.55	53.35	63.74	53.02	0.81*	0.33
Progeny of white flesh	Mean	194.31	172.07	194.36	172.30	-0.05	-0.23
	Percentage	98.75	87.32	97.18	86.15	1.57*	1.17*

 # The differences between predicted and realized response.
*** Significant at 0.05 level of probability.**
NS: Not significant.

These results agree with those of Gamie (2000) who found that white fleshed bulbs were increased in the first selection cycle. Predicted and realized genetic advances in progeny of white and pink fleshed bulbs (full or half sibs) descending from white and pink fleshed mother bulbs are presented in Tables (2 and 3). Predicted whites (full or half sibs) were more than realized in progenies of pink and white fleshed parents, respectively (Table 2). Oppositely, predicted pinks (full and half sibs) were less than realized in progenies of pink and white fleshed bulbs, respectively (Table 3). Differences in whites were significant in full and half sibs populations. In pinks, differences were insignificant (Tables 2 and 3).

Table 3: Predicted and realized genetic advance due to selection for pink flesh progenies of pink and white flesh (first selection cycle 1995/96).

genotypes		Predicted		Realized		Differences#	
		Full Sibs	Half sibs	Full sibs	Half sibs	Full sibs	Half sibs
Progeny of pink flesh	Mean	71.88	93.43	72.52	93.96	-0.64*	-0.53*
	Percentage	35.85	47.05	36.26	46.98	-0.41	0.07
Progeny of white flesh	Mean	4.67	26.84	5.64	27.70	-0.97*	-0.86*
	Percentage	0.91	12.35	2.82	13.85	-1.91*	-1.50*

 # The differences between predicted and realized response.
*** Significant at 0.05 level of probability.**
NS: Not significant.

B. Second selection cycle (C2):

In Table (4), it is clear that percentage of whites (full sibs) was highly significantly increased (to 99.5%) in the progeny of white fleshed bulbs detected a week after cutting mother bulbs. White (full sibs) were lowest (26-67%) in the progeny of pink fleshed mother bulbs. Oppositely, pinks (in full sibs) were significantly increased in the progeny of pink fleshed mother bulbs. Pinks (in full sibs) were lower in the progeny of white fleshed mother bulbs. Corresponding percentage were 75.33% and 0.5%, respectively. In Table (5 and 6), it is clear that predicted percent and mean number of whites in full sibs were higher than realized in progeny of pink fleshed mother bulbs detected right after cutting original mother bulbs.

Table 4: Mean, percentage and coefficient of variability (cv%) of white and pink flesh of Giza 20 onion cultivar (second selection cycle 1997-1998).

Genotypes	White flesh			Pink flesh		
	Mean Number	%	C.V%	Mean number	%	C.V%
Progeny of pink flesh						
Full sibs	49.34	26.67	5.85	150.66	75.33	2.03
Half sibs	124.28	46.96	3.07	75.72	53.04	2.88
Progeny of pink flesh a week after cutting						
Full sibs	184.14	75.60	1.91	15.86	24.40	6.26
Half sibs	130.40	69.55	2.07	69.60	30.45	5.02
Progeny of white flesh						
Full sibs	171.60	71.26	2.02	28.40	28.74	5.32
Half sibs	169.08	79.10	1.82	30.92	20.90	7.31
Progeny of white flesh a week after cutting						
Full sibs	199.00	99.50	1.51	1.00	0.50	11.44
Half sibs	173.34	85.42	1.69	26.66	14.58	10.48
S_0 parent Giza 20	106.64	53.32		93.36	46.68	
LSD 5%	22.88	10.43		9.70	11.05	
1%	30.34	13.82		12.86	14.65	

cv%: Coefficient of variability.

Oppositely, predicted percent and mean number of whites in full sib whites were less than realized in the progeny of white fleshed full sibs. Percentage of predicted whites were less than realized in the progeny of white fleshed mother bulbs immediately detected after cutting.

Percentage of predicted whites were more than realized in full sibs of the progeny of white mother bulbs detected immediately after cutting (Table 5), that of pink fleshed detected immediately after cutting and progeny of white fleshed mother bulbs detected a week after cutting (Table 6). Percentage of pinks were more than realized in full sib pink fleshed progenies of mother bulbs detected immediately after cutting, and half sibs detected immediately after cutting of white mother bulbs. Predicted pinks (Table 6) percentage were more than realized in half sibs of progenies of pink fleshed bulbs detected a week after cutting, but less than the realized in half sibs of progenies of white bulbs immediately detected after cutting.

Differences were insignificant between predicted whites or pinks in all other progenies not referred to above. Realized whites were never more than predicted in any progeny except in the progeny of white fleshed bulbs detected a week after cutting (full sibs).

Percentage of white fleshed bulbs in the initial population of Giza 20 was 55.7%. In the first selection cycle, it became 97.18% when white fleshed bulbs were selected and umbel/plant were selfed to produce full sibs. In the second cycle of selection, this rose to 99.52% when white fleshed bulbs were detected a week after cutting and arising plants were selfed to produce full sibs.

It is thus practically possible to develop 100% freedom from any pink color in the flesh of the Giza 20 bulbs if two cycles of selection were conducted and arising plants selfed.

Table 5: Predicted and realized genetic advance due to selection for white flesh (second selection cycle, 1997/1998).

genotypes	Predicted		Realized		Differences#	
	Full Sibs	Half sibs	Full sibs	Half sibs	Full sibs	Half sibs
Progeny of pink flesh						
Mean	48.86	124.15	49.34	124.28	-0.48*	-0.13
Percentage	24.41	46.89	24.67	46.96	-0.26*	-0.07
Progeny of pink flesh a week after cutting						
Mean	184.38	130.52	184.14	130.40	0.24	0.12
Percentage	75.68	69.69	75.60	69.55	0.08	0.14
Progeny of white flesh						
Mean	171.51	169.06	171.60	169.08	-0.09	-0.02
Percentage	71.09	79.15	71.26	79.10	-0.17*	0.05
Progeny of white flesh a week after cutting						
Mean	199.03	173.36	199.00	173.34	0.03	0.02
Percentage	99.52	85.39	99.50	85.42	0.02	-0.03

 # The differences between predicted and realized response.
*** Significant at 0.05 level of probability.**
N.S. = Not significant.

Table 6: Predicted and realized genetic advance due to selection for pink flesh of Giza 20 (second selection cycle, 1997/1998).

genotypes	Predicted		Realized		Differences	
	Full Sibs	Half sibs	Full sibs	Half sibs	Full sibs	Half sibs
Progeny of pink flesh						
Mean	151.02	75.79	150.66	75.72	0.36	-0.07
Percentage	76.02	53.12	75.33	53.04	0.69*	0.08
Progeny of pink flesh a week after cutting						
Mean	15.59	69.54	15.86	69.60	-0.27	-0.06
Percentage	24.26	30.30	24.40	30.45	-0.14*	-0.15*
Progeny of white flesh						
Mean	29.74	30.96	28.40	20.92	1.34*	0.04
Percentage	34.57	21.22	28.74	20.90	5.83*	0.32*
Progeny of white flesh a week after cutting						
Mean	0.58	26.64	1.00	26.66	-0.42	-0.02
Percentage	1.29	14.53	0.50	14.58	-0.79*	-0.05

 # The differences between predicted and realized response.
*** Significant at 0.05 level of probability,.**
N.S. = Not significant.

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تأثير الإنتخاب والتربية الذاتيه على لون اللحم فى أبصال الصنف جيزة 50

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أجرى هذا البحث فى محطة البحوث الزراعية بجزيرة شندويل – محافظة سوهاج – مركز البحوث الزراعية – مصر فى الفترة من 1994 وحتى 1998 لدراسة تاثير الإنتخاب والتربية الذاتية على صفة لون اللحم فى أبصال الصنف جيزة 20 وتبين من الدراسة مايلى:

زادت النسبة المئوية للأبصال بيضاء اللحم فى نسل الأبصال الأمية الخالية من اللون القرمزبذاتيه التربة فى الدورة الأولى للانتخاب.

كما زادت نسبة الأبصال بيضاء اللحم فى نسل الأبصال الأمية التى ظل لحمها أبيض لمدة أسبوع بعد تقطيعها فى الدورة الثانية للانتخاب.

الاستجابة المتوقعة للانتخاب بالنسبة لصفة لون اللحم الأبيض كانت أعلى من الاستجابة الفعلية فى الدورة الأولى للانتخاب.

كما أن الاستجابة الفعلية كانت اقل من المتوقعة بالنسبة لصفة لون اللحم الأبيض فى نسل الأبصال القرمزية اللحم والأبصال الأمية التى ظلت قرمزية اللحم بعد أسبوع من التقطيع فى الدورة الثانية للانتخاب.

وعلى هذا فإنه يمكن إنتاج أبصال الصنف جيزة 20 خالية تماماً من لون اللحم الأحمر وذلك باتباع التربية الذاتية والانتخاب لمدة دورتين إثنتين.