

## FERTILITY OF BALADI, FAYOUMI AND SOME EPIZOTIC BREEDS OF FOWL AS AFFECTED BY SOME GENETICAL, ENVIRONMENTAL AND PHYSICAL FACTORS

By  
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### SUMMARY

Eggs used in this study were produced at two farms :—

- (1) The Animal Breeding Research Farm of the Faculty of Agriculture, Giza.
- (2) The Liberation Province Poultry Farm.

From the former farm, eggs of Baladi, Fayoumi, White Leghorn and Rhode Island Red birds were available. Eggs collected from the Liberation Province Farm were of North Holland Blue, Fayoumi, White Leghorn and Rhode Island breeds. Comparison for fertility between these breeds as well as between the two localities were made. This study included also the effect of crossbreeding between some of these breeds. The results arrived at can be summarised as follows :

- (1) An average fertility of 82.48, 89.86, 91.97 and 81.89% was obtained for Baladi, Fayoumi, White Leghorn and Rhode Island Red eggs respectively at the Giza farm. In Liberation Province Farm the fertility was 83.41% for North Holland Blue, 90.02% for Fayoumi, 77.82% for White Leghorn and 88.34% for Rhode Island Red.

- (2) A highly significant difference in fertility was found between eggs from the two localities.

- (3) Crossbreeding had no effect on fertility except when crossing Rhode Island Red males with Baladi females, where an improvement was obtained.

- (4) The diallel crossing experiment showed non-significant differences between sires in fertility.

- (5) Variation in fertility due to month were found to be highly significant. There was a tendency for fertility in all breeds to decrease as summer approached (June-July).

- (6) Fertility was found to be positively correlated with egg production in Fayoumi and White Leghorn birds, while an opposite relation was obtained for Baladi and Rhode Island Red birds.

- (7) Eggs laid in one-egg-clutch had a lower fertility than others in the Fayoumi breed. In Baladi fertility declined with position in the clutch sequence.

- (8) Extremely small eggs at Giza and extremely large ones at Liberation Province farm had lower fertility than others.

- (9) Colour of the egg shell was found to have no definite relation to fertility.

- (10) A storage period from one to eight days had no effect on fertility.

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## INTRODUCTION

In either improving undeveloped stocks or attempting to build up new genetic combinations with higher potentialities, fertility is of paramount importance. In Egypt, two ways of improvement are being attempted. One is concerned with both Baladi and Fayoumi fowls as they are the best available indigenous birds, while the other involves the introduction and establishment of foreign breeds such as Rhode Island Red, North Holland Blue and White Leghorn.

Because there have been instances of loss of imported stocks through a decline in fertility, it was decided that a study should be made of the effects of some genetical, environmental as well as physical factors on the fertility of Fayoumi, Rhode Island Red, North Holland Blue and White Leghorn, along with certain of their crosses.

## MATERIAL AND METHODS

The eggs used in this study were collected from the Animal Research Farm of the Faculty of Agriculture in Giza, and from the Liberation Province Farm. A total number of 25,701 eggs was used throughout a period of two years. The details of the eggs used are given in Table 1.

In Giza, the Baladi and Fayoumi birds were kept in single breeding pens, each containing 10 hens and pullets and one cock. The yards of these pens were semi-covered. Flock mating was used in White Leghorn and Rhode Island Red, and in each house there were 20 pullets and hens with 2 cockerels. In Liberation Province, flock mating was used in all cases. In each house, 200 females were kept with 20 males. The houses were provided with open yards.

The feeding and management of the experimental birds in both localities were kept as uniform as possible throughout the period of study. Eggs used for each hatch were laid during a seven-or eight-days period previous to incubation. In both localities, eggs were collected several times daily and placed in an egg-holding room where the temperature and humidity were very similar to those outdoors.

All eggs were individually weighed to the nearest gram one day before setting. Measurements of the length and maximum diameter of each egg were taken by a caliper, measuring to the nearest tenth of a millimeter. Eggs were classified according to colour as light, medium and dark. This classification was done separately within each hatch. Eggs were classified according to shape, representing shapes commonly observed in the breeds studied.

In both localities, eggs were incubated in "Secura" electric forced draft incubators which were kept at 99°F. with a relative humidity of 70 - 80. In Giza, eggs were tested individually for "clears" on the seventh day of incubation. In the Liberation Province, eggs were not candled till the eighteenth day of incubation. On both farms, infertile eggs were broken out to detect infertility.

Means and standard errors for weight, length, maximum diameter, shape index and shell thickness were calculated. Analysis of variance with two criteria was carried out after transformation of all percentages to their corresponding angles, the angle being equal to arc sine percentage. Correlation coefficients were calculated to find out the relation between the different items studied. Methods used in this are those given by Snedecor (1950).

## RESULTS AND DISCUSSION

### 1.—*Breed and Locality* :

The fertility estimates for the breeds studied are shown in Table 2. Eggs laid by White Leghorns on the Giza farm show the highest fertility, followed by Fayoumi, Baladi and then Rhode Island Reds. Although El-Ayady and El - Ibiary (1957) reported a higher fertility for White Leghorn than Baladi, their figures for both breeds (87.1% and 62.3% respectively) were lower than those obtained in this study. They attributed the low fertility observed in Baladi eggs to early embryonic mortality which were considered as infertiles. They also admitted the possibility of a low ratio of males to females in laying flocks since the eggs were collected from individual farmers who usually run birds loose in the villages under conditions of fortuitous mating. In addition, eggs were collected all the year round. In this investigation, the eggs were collected

TABLE 1.—Eggs According to Origin, Year and Breed.

Breeds and Crosses	Giza Farm			Liberation Province Farm 1956/57	Grand Total
	1955/56	1956/57	Total		
Baladi ... ..	2312	—	2312	—	2312
Fayoumi ... ..	2576	1106	3782	2617	6299
W.L. ... ..	3303	—	3303	2322	5625
R.I.R. ... ..	3022	—	3022	2497	5519
N.H.B. ... ..	—	—	—	2220	2220
F.xR.I.R. ... ..	—	—	—	1008	1008
R.I.R.xF. ... ..	—	—	—	887	887
W.L.xB. ... ..	—	832	832	—	832
R.I.R.xB. ... ..	—	999	999	—	999
Total ... ..	11213	2937	14150	11551	25701

TABLE 2.—Fertility of Breeds at Giza.

Breeds	No. of eggs set	No. of fertile eggs	Fertility%
Baladi ... ..	2312	1907	82.48
Fayoumi ... ..	2576	2315	89.86
W. Leghorn ... ..	3303	3038	91.97
R.I.R. ... ..	3022	2475	81.89

TABLE 3.—Fertility of Different Breeds in Giza and Liberation Province at Similar Months.

Locality	Items	Breed			
		F.	W.L.	R.I.R.	N.H.B.
Giza ...	No. of eggs set	738	1009	937	—
	No. fertile ...	681	975	837	—
	Fertile % ...	92.20	96.65	89.32	—
Liberation Province	No. of eggs set	2617	2322	2497	2220
	No. fertile ...	2356	1807	2206	1853
	Fertile % ...	90.02	77.82	88.34	83.46

TABLE 4.—Analysis of Variance of Fertility of the Different Breeds in Two Localities

Source of variation	D.F.	S.S.	M.S.
Between breeds ... ..	2	116.98	58.49
Between localities... ..	1	391.60	391.60**
Interaction ... ..	2	564.28	282.14**
Remainder ... ..	46	1439.86	31.30
<b>Total ... ..</b>	<b>51</b>	<b>2512.72</b>	

\*\* Highly significant.

during the period from November to July. Since fertility is affected by hot weather, lower fertility would be expected from the eggs used by El-Ayady and El-Ibiary (1957). For this same reason, a value of only 81.5% was reported by Hafez and Kamar (1955) for fertility in Fayoumi fowls, compared with 89.86% and 90.02% obtained in this study in Giza and Liberation Province respectively. The low fertility reported by Amer *et al* (1957) for Rhode Island Reds and White Leghorns (79.1% and 78.2% ) may be due to the eggs not being carefully handled during or after their air-trip. The estimate obtained by the same authors for Egyptian eggs (mixture of Fayoumi and Baladi eggs) is close to the average for both breeds obtained in this study.

For practical reasons, each breed in the Liberation Province was studied at a particular time which was not necessarily the same for the others under study but eggs laid at the same period of time, although not the same year, in both Giza and Liberation Province flocks, have been compared with each other. The comparisons are given in Table 3. These show a higher fertility for the Giza flock than for that of the Liberation Province. The small difference in fertility between the Fayoumi flocks of the two farms may be due to the fact that the Liberation Province flock came originally from the Giza flock. However lower fertility values are to be expected in all breeds in Liberation Province, because incubated eggs were not candled till the eighteenth day of incubation and this might mean that some of the early dead embryos which were probably putrified could be classified as clears.

The analysis of variance for the effect of both breeds and localities (Table 4) shows that difference in fertility between breeds, irrespective of locality, was not significant.

but that there is a highly significant difference due to locality. There is also a highly significant effect for interaction between breed and locality, but it is not possible to define the reason for this difference. Possibly it could be due to some factor in management or possibly some local environmental factor which cannot be controlled by management.

### 2.—*Effect of Crossbreeding*

Lower fertility values than those of the parental breeds resulted from crossing White Leghorn males with Baladi females and Fayoumi males with Rhode Island Red Females. No improvement in fertility was obtained by crossing Rhode Island Red males with Fayoumi (Table 5). This agrees with the findings of Knox (1939), Bernier (1947), King and Brukner (1952) and Ragab et al (1956). However, a higher fertility value was obtained from crossing Rhode Island Reds with Baladi than was obtained in the pure breeds. This result conflicts with the findings of Dunn (1927), Curtis and Lambert (1929) and Bernier and Trulsson (1939), who found that semen of males from a given breed is more effective in fertilizing ova from the same breed than ova from another breed.

### 3.—*Effect of Sire*

In order to study the effect of sire on fertility, a diallel crossing experiment was carried out. The material used consisted of three sires and three female sets, each comprising seven dams. Each sire was mated alternately to the three groups of dams. The analysis of variance shows that the variance between sires when compared with the remainder does not give a significant for F. (Table 6). This means that the sires used in this experiment were not significantly different from each other in the fertility of eggs of their mated hens.



TABLE 5. — Number and Percentage of Fertile Eggs in Pure Breeds and Their Crosses.

Locality	Breed or Cross	No. of eggs set	No. of fertile	Fertile eggs per cent.
Giza	Baladi ... ..	2312	1907	82.48
	W.L. ... ..	3303	3038	91.97
	R.I.R. ... ..	3022	2475	81.88
	W.L. × Baladi ...	832	623	74.87
	R.I.R. × Baladi ...	999	892	89.28
Liberation Province	Fayoumi ... ..	2612	2356	90.02
	R.I.T. ... ..	2497	2206	88.34
	F. × R.I.R. ... ..	887	726	81.84
	R.I.R. × F. ... ..	1008	915	90.77

TABLE 6.—Analysis of Variance of Fertility (Diallel Crossing Experiment).

Source of variation	D.F.	S.S.	M.S.
Total ... ..	62	8699.62	—
Between sires ... ..	2	537.37	268.68
Between sets of dams ... ..	2	397.87	198.93
Interaction ... ..	4	394.40	98.60
Remainder ... ..	54	7369.98	136.48

#### 4.—*Effect of Month*

Throughout the period of study in Giza, which lasted from November to July, monthly variations in fertility were observed, for all breeds studied. In Baladi and Rhode Island Reds, maximum fertility was attained in November, while the minimum for both breeds occurred in May. The maximum fertility for Fayoumi and White Leghorn was obtained in February, while the lowest value for both was in July. However, the analysis of variance shows that there is a highly significant breed difference in fertility as well as in monthly variations, and also that the variance due to interaction between breed and month is highly significant (Table 7). In other words, the different breeds show different patterns of monthly variation.

Although this study does not cover the whole year fertility of all breeds shows a tendency to decrease as summer approaches (May, June and July). Thus, seasonal variation in fertility obtained in this study is similar to those reported by Hafez and Kamar (1955), Amer et al (1957) and El-Ayadi and El-Ibiary (1957) in Egypt. These results also agree with those obtained for foreign breeds in other countries by Upp and Thompson (1927), Kumanoff (1941), Funk (1938) Parker and McSpadden (1942), Malmstrom (1943), Montmayer (1936) and Blyth (1945).

#### 5.—*Egg Production and Fertility*

Correlation coefficients between egg production of the different breeds during the breeding season and fertility have been calculated (Table 8). The value obtained for White Leghorn birds suggests that high producers give more fertile eggs. This agrees with the observations of

TABLE 7.—Analysis of Variance of Fertility.

Source of variation	D.F.	S.S.	M.S.
Total ... ..	111	6298.85	—
Between breeds ... ..	3	730.52	243.51**
Between months ... ..	7	1072.42	153.0**
Interaction ... ..	21	2438.69	116.17**
Remainder ... ..	80	2057.22	25.71
** Highly significant.			

TABLE 8.—The Correlation Coefficient Between Fertility and Egg Production.

Breed	No. of birds	Av. egg production	Cor. Coeff.
Baladi ... ..	53.0	37	-0.0374
Fayoumi ... ..	46.5	42	±0.0382
W. Leghorn ... ..	50.1	58	±0.616 **
R.I.R. ... ..	50.1	58	-0.0125

\*\* Highly significant.

Warren and Kilpatrick (1929), Nicholsides (1934), Lamoreux (1940), Malmstrom (1943) and Bernier (1947). It also confirms the findings of Hauser (1916) who obtained a correlation coefficient of  $0.609 \pm 0.109$  between the number of matings and the rate of production. The positive correlation coefficient obtained for Fayoumi birds and the negative ones for Baladi and Rhode Island Reds was found to be non-significant.

#### 6.—*Size of Clutch*

Table 9 shows the relation of size to fertility results in Baladi and Fayoumi eggs. In both breeds, no definite relations has been established. This disagrees with the results obtained by Funk (1939), Lamoreux (1940) and Ghany (1955).

#### 7.—*Position of the egg in clutch*

There was a tendency for fertility to decline in Baladi eggs as the sequence of eggs in any clutch increase (Table 9). In Fayoumi eggs (Fig. 8) no definite trend was observed. Similar results were obtained by Funk (1939), Lamoreux (1940) and Ghany (1955).

#### 8.—*Egg weight*

The number and percentage of fertile eggs of the different breeds in Giza and Liberation Province farms are shown accordingly to weight in Tables 10 and 11, and are graphically represented in Figure 9 and 10. In Giza, it is clear that extremely small eggs have a remarkably low fertility value for White Leghorns, Rhode Island Reds, and Fayoumis. In Baladis, both extremely small or extremely large eggs have lower fertility values



TABLE 10.—Number and Percentage of Fertile Eggs of Native Breeds According to Weight.

Weight (Gram)	Giza						Liberation Province		
	Baladi			Fayoumi			Fayoumi		
	No. of eggs set	No. fert.	% fert.	No. of eggs set	No. fert.	% fert.	No. of eggs, set	No. fert.	% fert.
32	25	17	68.0	18	14	77.7	5	4	80.0
34	51	38	74.5	40	38	95.0	11	11	100.0
36	129	105	81.3	111	97	87.3	89	82	92.1
38	270	223	82.5	242	227	93.8	241	212	82.9
40	440	386	87.7	434	400	92.1	503	448	83.7
42	432	386	89.3	507	460	90.7	644	579	89.9
44	379	318	83.9	423	281	90.0	453	405	82.4
46	261	210	80.4	292	283	86.6	321	291	90.6
48	159	124	77.9	148	128	87.1	239	213	89.1
50	102	64	62.7	118	110	93.2	67	65	97.0
52	30	17	56.6	39	36	92.3	32	31	96.8
54	10	9	90.0	15	15	100.0	7	5	71.4
Total ...	2288	1897	82.9	2387	2160	90.5	2612	2347	89.8

TABLE II.—Number and Percentage of Fertile Eggs of Foreign Breeds According to Weight.

	Giza						Liberation Province								
	W.L.			R.I.R.			W.L.			R.I.R.			B.H.		
	No. of eggs set	No. fert.	% fert.	No. of eggs set	No. fert.	% fert.	No. of eggs set	No. fert.	% fert.	No. of eggs set	No. fert.	% fert.	No. of eggs set	No. fert.	% fert.
38	22	18	81.8	—	—	—	—	—	—	—	—	—	—	—	—
40	37	20	54.3	10	7	70.0	—	—	—	—	—	—	—	—	—
42	46	36	78.2	16	11	68.7	—	—	—	—	—	—	—	—	—
44	97	74	76.2	50	42	84.0	—	—	—	—	—	—	—	—	—
46	195	153	78.4	111	76	68.4	2	2	100.0	—	—	—	—	—	—
48	224	173	77.2	138	114	84.4	18	16	88.8	—	—	—	—	—	—
50	439	318	72.4	312	280	89.7	47	35	74.4	—	—	—	—	—	—
52	434	365	84.1	403	369	91.5	216	158	73.1	—	—	—	—	—	—
54	368	329	89.4	482	445	92.3	265	202	76.2	—	—	—	—	—	—
56	417	360	86.3	558	525	94.0	351	263	74.9	—	—	—	—	—	—
58	239	206	86.1	356	325	91.2	381	298	78.2	—	—	—	—	—	—
60	293	225	85.5	371	354	95.4	383	297	77.9	—	—	—	—	—	—
62	100	86	86.0	202	188	93.0	261	216	82.7	—	—	—	—	—	—
64	63	51	80.9	145	139	95.8	153	124	82.7	—	—	—	—	—	—
66	37	33	89.9	87	84	96.5	132	106	80.3	—	—	—	—	—	—
68	19	15	78.9	27	25	92.5	71	62	87.3	—	—	—	—	—	—
70	17	16	94.1	22	20	90.9	28	21	72.4	—	—	—	—	—	—
72	3	3	100.0	—	—	—	15	8	53.3	—	—	—	—	—	—
74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	3020	2481	82.1	3237	3004	91.3	2324	1808	77.8	2477	2100	88.4	2219	1863	83.9

than those which are medium in size (42 grams). In Liberation Province, where very small eggs of any breed were not incubated, the eggs in other weight classes showed more or less similar values. It can be concluded from the results on both farms that best fertility results can be obtained from Baladi eggs weighing 40 to 44 grams while Fayoumi eggs weighing 34 grams to 52 grams also have good fertility values. Eggs from White Leghorn, Rhode Island Red and North Holland Blue, which are less than 52 grams or more than 66 grams, are best discarded.

#### 9.—*Egg shell colour*

Although classification of colour was carried out within each breed separately, there is no constant relation between colour and fertility, which can be generalised for all breeds. In Baladi eggs, those having medium or dark coloured shells show a higher fertility than white ones. In both localities, white and medium coloured Fayoumi eggs have a higher fertility than darker ones. In Rhode Island Red eggs from the Giza farm, the darkest eggs have the highest fertility, while in the Liberation Province those medium in colour have the best fertility. Ghany (1955) found no relation between shell colour and fertility, though Funk and Forward (1949) observed that in summer hatches only the darker brown eggs had better fertility.

#### 10.—*Storage period*

It appears from Tables 12 and 13 that the storage period has no definite relation to the apparent fertility of the different breeds on either farms. A similar result was reported by Ghany (1955). In both cases this may be due to the fact that the storage period did not exceed



TABLE 12.—Number and Percentage of Fertile Eggs According to Storage Period (Giza Farm).

Breed	Storage Period (Days)							
	1	2	3	4	5	6	7	8
No. of eggs set... ..	107	343	353	317	307	353	316	201
No. of fertile eggs ...	99	288	293	262	251	274	269	170
Fertility percentage	92.52	83.96	83.00	82.64	81.75	77.62	85.12	84.52
<b>Fayoumi</b>								
No. of eggs set... ..	111	337	358	303	333	342	325	222
No. of fertile eggs ...	101	312	325	279	310	317	286	202
Fertility percentage	90.19	89.67	90.76	92.07	93.09	92.69	88.00	88.98
<b>White Leghorn</b>								
No. of eggs set ... ..	95	494	484	477	489	469	475	325
No. of fertile eggs ...	85	449	440	434	453	434	436	301
Fertility percentage	89.47	90.89	90.90	90.98	92.63	92.53	91.78	92.61
<b>White Leghorn</b>								
No. of eggs set ... ..	94	434	413	408	457	442	418	341
No. of fertile eggs ...	84	349	326	332	378	376	333	265
Fertility percentage	89.36	80.41	78.93	81.34	82.70	85.10	79.66	77.71

TABLE 13.—Number and Percentage of Fertile Eggs According to Storage Period  
(Liberation Province Farm).

Breed	Storage period (Days)								
	1	2	3	4	5	6	7	8	
North Holland Blue	No. of eggs set ...	213	442	304	352	490	406	12	—
	No. of fertile eggs ...	180	364	250	292	406	348	12	—
	Fertility percentage	84.50	82.35	82.23	82.95	82.85	85.71	100.00	—
Fayoumi	No. of eggs set ...	14	192	179	489	441	493	523	290
	No. of fertile eggs ...	11	168	156	445	399	447	478	256
	Fertility percentage	78.57	87.50	87.15	91.00	90.47	90.66	91.39	88.27
White Leghorn	No. of eggs set ...	261	419	418	431	345	424	25	—
	No. of fertile eggs ...	200	329	321	335	266	334	19	—
	Fertility percentage	76.62	78.52	76.79	77.72	77.10	78.77	79.16	—
R.I.R.	No. of eggs set ...	46	326	328	463	473	369	356	225
	No. of fertile eggs ...	42	287	312	416	328	322	311	188
	Fertility percentage	91.30	88.03	95.12	89.84	87.93	87.26	87.35	83.55

eight days. In fact, length of storage period can have no effect on biological fertility, since fertilisation takes place within the body of the hen. Thus, any bad effect of storage period only hinders the fertilized blastodisk from growing at all or causes death of the embryo at an early stage of development.

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## الملخص

### تأثير بعض العوامل الوراثية والبيئية والطبيعية على الخصب في الدجاج البلدى والفيومى وبعض الأنواع الأجنبية

شملت الدراسة ٢٥٧٠١ بيضة جمعت من مزرعتى كلية الزراعة بجامعة القاهرة ومديرية التحرير في مدة عامين ، وتتلخص النتائج التى أسفر عنها البحث فيما يلى :

بلغ متوسط الخصب فى بيض كل من الدجاج البلدى والفيومى واللجهورون الأبيض والرود ايلند المجموع من مزرعة كلية الزراعة ٨٣٤٨٪ ، ٨٩٨٦٪ ، ٩١٩٧٪ ، ٨١٨٩٪ على التوالى . أما بالنسبة للبيض المجموع من مزرعة مديرية التحرير فقد كان متوسط الخصب ٨٣٤١٪ للهلونسى الأزرق و ٩٠٠٢٪ للفيومى و ٧٧٠٨٢٪ للجهورن الأبيض و ٨٨٣٤٪ للرود ايلند . وقد كانت الفروق بين نسبة الخصب فى الأنواع بين المزرعتين ذات دلالة معنوية إحصائية مما يدل على أن لكل بيئة أثرها المميز على خصب البيض .

وقد تبين أن الخلط بين الأنواع لم يكن ذا أثر على الخصب إلا فى حالة خلط ديوك الرود ايلند بأناث من البلدى حيث لوحظ تحسین معقول .

أما الخلط المتبادل من الأنواع فلم يسفر عنه أى فروق فى نسبة الخصب نتيجة لتغير الديوك .

هذا وقد اتضح أيضاً أن نسبة الخصب تختلف من شهر إلى آخر على مدار العام مع اتجاه للنقص فى شهور الصيف رخصواً فى شهرى يونيه ويوليه .

أما بالنسبة لعلاقة معدل وضع البيض بالخصب فقد وجد أن هناك علاقة إيجابية بين هذا المعدل وبين الخصب فى كل من الدجاج الفيومى واللجهورن

الأبيض وبالتالي فقد كانت العلاقة سلبية في البلدى والرود أيلند . هذا بالإضافة إلى أنه قد لوحظ. أن البيض الموضوع في سلسلة وضع مفردة ذو خصب منخفض وذلك في الدجاج الفيومى أما في البلدى فقد لوحظ. أن الخصب ينخفض كلما زاد عدد البيض في السلسلة .

ولوحظ أيضاً أن البيض الصغير جداً في مزرعة الجيزة والكبير جداً في مزرعة التحرير كان منخفضاً في نسبة التفريخ أكثر من مثيله في المزرعة الأخرى . كما وجد أن لون البيض ليس له أى أثر على نسبة الخصب .

أما مدة التخزين فقد تبين أنها إذا تراوحت بين يوم واحد وثمانية أيام لم تسبب أى ضرر على نسبة الخصب أما إذا زادت عن ذلك فإن نسبة الخصب تتأثر .