Second Egyptian-British Conference on Animal and Poultry Production

August 26th - 28th, 1986
BANGOR, U.K.

University College of North Wales
Bangor

University of Zagazig
Egypt

OBSERVATIONS ON PUREBRED AND CROSSBRED LITTERS OF GIZA WHITE AND GREY GIANT FLANDER RABBITS IN EGYPT

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SUMMARY

Litter size and weight at birth and at weaning in addition to pre-weaning litter losses were investigated using purebred and single crossbred litters produced by Giza White (G) and Grey Giant Flander (F) rabbits.

The overall least squares means of litter size at birth and at weaning were 6.4 and 3.4 young, respectively. The corresponding estimates for litter weight were 333 and 1389 gm. The percent of pre-weaning litter losses averaged to 47.0%. The effects of breed group, age of doe and parity on litter traits studied were not significant. Month of kindling constituted an important factor influencing ($P < 0.01$) all traits studied. Pre-weaning litter losses increased insignificantly with the increase of litter size at birth.

Crossbreeding between G and F rabbits was associated with the presence of heterotic effects on litter size and weight at birth and at weaning and also with a reduction in pre-weaning litter losses.

INTRODUCTION

The productive efficiency of rabbit raising depends to a great extent on litter size, litter weight and preweaning litter mortality produced by the doe. The roles of breed selection and/or crossbreeding on preweaning litter traits are less well established in rabbits than in other livestock species. In Egypt, crossbreeding as a tool for improving such traits was studied by a few investigators (Afifi <u>et</u> <u>al</u>., 1976ab; Emara, 1982; Afifi and Emara, 1984ab).

Crossbreeding has been utilized in rabbit breeding to exploit both additive and nonadditive genetic variation. Comparisons between purebred groups reflect combined additive and maternal breed effects, while comparisons between crossbred and purebred groups involve genetic contributions (Lukefahr et al., 1984). The present paper reports the effects of the reciprocal crossing between Giza White and Grey Giant Flander breeds of rabbits on litter size and weight traits and preweaning litter losses. The effect of breed group and some environmental factors was also presented.

MATERIALS AND METHODS

A crossbreeding experiment using Giza White and Grey Giant Flander breeds of rabbits was done in the Experimental Farm of the Faculty of Agriculture at Moshtohor near Cairo, Zagazig University, Banha Branch. It lasted for one year of production (1978/79) only. The breeding plan followed permitted the simultaneous production of Giza White (G), Grey Giant Flander (F), Giza White-Grey Giant Flander (GF) and Grey Giant Flander-Giza White (FG) litters. Females of each of the two breeds used were divided into two groups, those of the 1st group were mated with bucks from their breed while those of the 2nd group were mated with bucks from the other breed. According to the breeding plan, bucks were assigned at random to breed the does with a restriction to avoid full-sib and half-sib matings. Each buck was allowed to sire litters given by 4-5 does allover the year of the study.

Breeding does and bucks were kept in separate wired hutches in the rabbitry. At the time of breeding, does were transferred to the bucks' hutches to be mated and returned to their hutches. They were hand mated to assure copulation and were palpated 10 days thereafter to determine pregnancy. Those failed to conceive were returned to the same bucks of the previous service to be rebred. All does were rebred 7 days after kindling. Weaning of the litters was performed five weeks after birth.

Rabbits were always fed ad-libitum and feeds were introduced three times daily. A dry concentrate ration of about 16% total protein and 60% starch equivalent was provided in the morning and in the evening. At noon, Barseem (Trifolium alexandrinum) was provided in season, during the other months it was substituted with Barseem hay and/or Darawa (green maize plants). Fresh clean water was available to rabbits all times. Other details of managerial procedures were described by Afifi and Kadry (1984).

Data were collected on litter size and weight at kindling and at weaning in addition to the percent of preweaning litter losses. Kindling observations were recorded within 12 hours after kindling while those of weaning were taken in time. The statistical analysis was done by employing the Least-Squares procedures shown by Harvey (1960). A linear model included the fixed effects of breed group, age of doe at conception, parity and month of kindling were used for analyzing these data. Tests of significance for differences between constants or means of the different levels of each factor were done according to Duncan (1955). Heterosis percent was calculated as the relative increase of the average performance of the crossbred litters over that of those of mid-parents. Records of the percent of preweaning litter losses were subjected to arc-sin transformation before being analysed in order to approximate normal distribution.

RESULTS AND DISCUSSION

Litter size

The average size of all litters at birth included in the present study was 6.4 young which falls within the ranges obtained by other Egyptian investigators (Afifi et al., 1976b; Afifi et al., 1982a; Afifi et al., 1982b; Emara, 1982), estimates ranged from 5.9 to 6.7. At weaning, the average litter size (3.4 young) was lower than those reported by the same Egyptian authors which ranged between 4.9 to 5.9 young.

Litter size varied with breed group but without significant differences at birth and at weaning (Table 1). A positive association

Table 1. Least-squares constants[+] or means, standard errors and tests of significance (F values) for factors affecting litter traits in Grey Giant Flander, Giza White rabbits and their reciprocal crosses.

	Birth data			Weaning data			Preweaning litter losses‡ (%)	
	No.	Litter size	Litter weight	No.	Litter size	Litter weight		
		Constant±S.E.	Constant±S.E.		Constant±S.E.	Constant±S.E.	No.	Mean
General mean	108	6.4±0.3	333±17	92	3.4±0.5	1389±217	108	47.6
Breed group:		F=1.3 NS	F=0.6 NS		F=0.1 NS	F=0.4 NS		F=0.2 NS
FF	15	-0.1±0.5a	12±22a	11	-0.2±0.4a	-130±175a	15	49.6a
GG	26	0.0±0.4a	-24±20a	24	0.0±0.4a	28±145a	26	51.4a
FG	33	-0.5±0.3a	- 3±16a	29	0.0±0.3a	129±124a	33	46.2a
GF	34	0.6±0.4a	15±99a	28	0.2±0.3a	- 27±134a	34	43.0a
Age of doe at conception:		F=0.5 NS	F=0.4 NS		F=0.9 NS	F=0.7 NS		F=1.1 NS
≤ 9 months	11	-1.5±1.1a	-30±52a	10	-0.7±0.8a	219±330a	11	44.2a
10-12 months	33	-0.8±0.8a	- 3±40a	28	-0.9±0.6a	- 44±242a	33	61.4a
13-15 months	23	0.1±0.8a	- 5±38a	22	-0.2±0.6a	56±231a	23	44.8a
16-18 months	5	0.2±0.9a	-45±45a	3	-0.6±0.9a	-521±368a	5	77.4a
19-21 months	3	0.6±1.3a	17±60a	29	2.4±1.5a	290±588a	3	55.4a
≥ 22 months	33	1.4±1.4a	67±69a				33	21.5a
Parity:		F=0.7 NS	F=0.6 NS		F=0.5 NS	F=0.2 NS		F=0.2 NS
1st	32	1.2±1.1a	19±51a	27	0.9±1.0a	-189±400a	32	33.7a
2nd	28	0.1±0.8a	- 4±41a	26	0.9±0.8a	- 11±341a	28	36.7a
3rd	12	0.3±0.8a	35±39a	11	0.7±0.8a	178±338a	12	51.0a
4th	5	-0.2±1.2a	8±59a	2	-0.9±1.4a	74±578a	5	54.4a
≥5th	31	-1.4±1.3a	-58±64a	26	-1.6±1.0a	- 52±423a	31	62.3a
Month of kindling:		F=3.7 **	F=3.8 **		F=8.0 **	F=13.7 **		F=9.7 **
September-October	23	-1.2±0.5a	-75±25a	12	-1.6±0.5a	-809±215a	23	91.6a
November-December	17	-0.7±0.5a	-10±26ab	18	0.7±0.4bc	452±178b	17	21.2b
January-February	36	0.1±0.4a	30±20b	33	1.4±0.4b	801±150b	36	27.3b
March-April	28	1.5±0.5b	49±22b	26	1.2±0.4b	525±156b	28	32.6b
May	4	0.4±1.0ab	6±49ab	3	-1.7±0.9ac	-969±367a	4	60.6ab

[+] The appearance of the same letter with two constants or means within the same classification, signifies that they do not differ significantly ($P < 0.05$), otherwise they do.

‡ Means of preweaning litter losses (%) were obtained by the retransformation from arc-sin to original scale.

** ($P < 0.01$); NS ($P > 0.05$)

between ovulation rate and weight of the breed may have accounted for this observation (Venge, 1950; Hulot and Matheron, 1979). Poorer maternal ability of Giza White does at kindling and weaning, i.e. failure to provide an adequate nest and milk, was chiefly responsible for the lowered proportion of bunnies born and weaned of GG and FG litters compared with FF and GF litters. In agreement with the present findings, Afifi *et al.* (1976b) and Emara (1982) with different breeds of rabbits and their crosses found that differences in litter size due to breed group effects were not significant at birth and at weaning.

Heterosis percentages given in Table 2 indicate that crossbreeding between G and F rabbits was associated with the presence of heterotic effects on litter size either at birth or at weaning with the exception of litter size at birth in FG litters. However, crossbreeding in rabbits was generally associated with the establishment of heterotic effects on litter size at birth and at weaning (Zelnik and Granat, 1973; Afifi *et al.*, 1976b, Matheron and Rouvier, 1979; Emara, 1982; Lukefahr *et al.*, 1983ab).

Table 2. Heterosis percentages for litter traits of FG and GF crossbred litters

	Heterosis percentages for:	
Litter traits	FG	GF
Litter size at birth	-7.4	10.0
Litter size at weaning	3.3	7.0
Litter weight at birth	1.1	6.3
Litter weight at weaning	12.5	1.8

Maternal and sex-linkage effects on litter size at birth and at weaning expressed in the differences between the two reciprocal crossbred combinations (FG and GF) were limited and non-significant (Table 1). The same results were obtained by Afifi *et al.* (1976b) and Emara (1982) for three and six pairs of reciprocal crossbred combinations, respectively.

Litter size at birth and at weaning changed slightly and non-significantly with age of doe (Table 1). This is in agreement with the other studies (El-Khishin et al., 1951; Ragab and Wanis, 1960; Casady et al., 1962; Afifi et al., 1982a; Emara, 1982).

Litter size decreased insignificantly with advance of parity (Table 1). Most studies (Afifi et al., 1976b; Hulot and Matheron, 1981; Emara, 1982) have shown a general trend indicating that litter size at birth increased (P > 0.05) progressively as parity advanced. The pattern of change in litter size at birth due to parity effects may be resultant of changes in physiological efficiency of the doe which occurs with advance in parity especially those related to ovulation, implantation and prenatal survival rates and due to differences in the intra-uterine environment during gestation length.

There was a general tendency for litter size at birth and at weaning to be low in the early months of the year of production (September and October) and to increase (P < 0.01) as month of year of kindling advanced and to decrease (P < .01) again at the end of the year of production during May (Table 1). This trend was observed by other Egyptian investigators (El-Khishin et al., 1951; Khalil, 1980; Emara, 1982). Differences in average litter size at weaning for the present and other Egyptian studies may be attributed to differences in litter losses during the suckling period which occurred in litters born at different months. However, changes in litter size with littering dates might be attributed to changes in the availability of green fodder, its nutritive value and in weather conditions (especially ambient temperature) which are associated with different months of the year. In conclusion, the relative sizes of F-values of all factors included in the model of analysis (Table 1) indicate that month of kindling constituted the most important factor influencing (P < 0.01) litter size at birth and at weaning.

Litter weight

The overall least-squares mean of litter weight was 333 gm at birth and 1389 gm at weaning (Table 1). These means are, in general, less than their correspondings obtained in different Egyptian studies (Afifi et al., 1976a; Afifi et al., 1982a; Afifi et al., 1982b; Afifi and Emara, 1984a).

The better prenatal maternal ability of F does than that of G does was evident since both purebred and crossbred litters produced by F does was heavier (P > 0.05) than those produced by G does (Table 1). At weaning, the reverse was observed, i.e. G does were superior to F does for milk production. Non-significant differences in litter weight due to breed-group effect were reported by Afifi et al. (1982a) and Afifi et al (1982b). The reverse was observed by Lukefahr et al. (1983ab), Afifi and Emara (1984a) and Lukefahr et al. (1984).

The positive heterosis percentages estimated for litter weight of FG and GF crossbred litters evidenced the presence of heterotic effects (Table 2). Therefore, crossing between F and G rabbits was associated with the presence of hybrid vigour in litter weight at birth and at weaning. Afifi et al. (1976a) and Afifi and Emara (1984a) came to the same conclusion.

Differences between the two reciprocal crossbred combinations (FG and GF) for litter weight at birth and weaning were not significant (Table 1). Accordingly, effects of maternal abilities and sex-linkage on litter weight at both ages were not evidenced. However, the existence of reciprocal differences between crossbred litters for litter size and weight may have been a reflection of heavy body weight of the doe as well as the substantial differences in milking ability.

Age-of-doe effects did not show neither considerable nor significant contribution to the variance of litter weight at birth and at weaning (Table 1). Similar results were reported by other Egyptian investigators (Afifi et al., 1976a; Afifi et al., 1982a; Afifi et al. 1982b; Afifi and

Emara, 1984a). Afifi and Emara (1984a) interpreted changes in litter weight at birth with advance in age of doe as a reflection of age changes in ovulation rate and in the ability of the doe to supply her young with nourishment during pre-natal growth. At weaning, changes in litter weight due to changes in age of doe refer mainly to changes in the postnatal maternal abilities especially those associated with milk production.

Litter weight at birth and at weaning changed ($P > 0.05$) as sequence of litter (parity) advanced. The heaviest litter weights were recorded in the third parity at both ages. However, no pattern of parity effects on litter weight at both ages was observed. Afifi et al. (1976a) reported that the factor that played the role in expressing differences in litter weight between parities were of nutritional and climatic origin. It is thought that these factors are not the sole causes of parity differences in litter weight at both ages. But changes in physiological efficiency of the doe (especially those associated with the intra-uterine environment provided during pregnancy as well as milk production and the ability of the doe to suckle its young until weaning) which occur with advance of parity may be considered as another cause in this concern. Holdas and Szendro (1982) concluded that milk yield of does increased as parity advanced.

Litter weight increased with month of kindling from September-October to November-December, reached its maximum in March-April at birth and in January-February at weaning and decreased thereafter until May (Table 1). Afifi and Emara (1984a) observed similar trend but the peak of litter weight at both ages was reached by litters kindled in March-April. Afifi et al. (1976a) attributed this trend to the fact that during the early months of the year of production, the green fodder for the pregnant does is not available in enough quantities and is of lesser nutritive value, as the month of kindling advances fodder becomes more abundant and of high nutritive value and the weather becomes milder. Towards the end of the year of kindling there is a lack of green fodder and the weather becomes warmer and less favourable. As for litter size, month of kindling was the most important factor influencing ($P < 0.01$) litter weight at both ages studied. Khalil (1980) and Emara (1982) came to the same conclusion.

Preweaning litter losses

The 47.6% of preweaning litter losses (Table 1) are nearly similar to 48.0% estimated by Afifi et al. (1982a) and less than the 56.3% reported by Afifi and Emara (1984b).

The preweaning litter losses varied insignificantly from one breed group to another (Table 1). This agrees well with the findings of Zelnik and Granat (1973), Afifi et al. (1982a) and Lukefahr et al. (1984). On the contrary, Khalil (1980) observed that breed differences in preweaning litter mortality were significant ($P < 0.05$). The contradicting results obtained by the different workers in this respect may be due to differences in the samples of the breeds of rabbits used in addition to the different effects of breed-environment interaction.

The crossbred litters of FG or GF were lower ($P > 0.05$) in preweaning losses than those of purebred litters (Table 1). These findings show that crossbreeding between F and G rabbits was associated with a reduction in preweaning litter losses. Rollins and Casady (1964) and Lukefahr et al. (1983a) found that mortality of the young rabbits until weaning was significantly less for the crossbred than for the purebred rabbits. However, Zelnik and Granat (1973), Lukefahr et al. (1984) and Afifi and Emara (1984b) observed an opposite trend. Differences in preweaning losses in litters of the two reciprocal crossbred combination (FG and GF) were negligible (3.2%) and non-significant (Table 1). This agrees with findings of Lukefahr et al. (1983a) and Afifi and Emara (1984b).

Preweaning litter losses changed with advance of age of doe but without either definable trend or significant differences (Table 1). Similar results were reported by other Egyptian investigators (Khalil, 1980; Afifi et al., 1982a; Afifi and Emara, 1984b).

The percent of litter losses until weaning increased insignificantly as parity advanced up to the 5th (Table 1). Afifi et al. (1982a) and Emara (1982) reported that the percent of litter losses during the suckling period increased from the 1st to the subsequent parities. Most of the studies (Rouvier et al., 1973; Mowlem, 1977; Khalil, 1980) reported that preweaning mortality rate decreased as parity sequence advanced till a definite parity, then increased again in the later subsequent parities. This trend is thought to be due to the improvement in the care and ability of the doe to suckle her young with advance of parity sequence.

Litter losses differed ($P < 0.01$) with month of kindling (Table 1). Litters kindled during November-December months showed the least preweaning losses (21.2%) while those kindled during September-October recorded the highest losses (91.6%). However, differences in preweaning litter mortality due to month-of-kindling effects were attributed to differences in nutrition (Scholaut, 1982), atmospheric temperature (Afifi et al., 1982a) and disease conditions (Lukefahr et al., 1984) which usually differ from one month to another. Khalil (1980) stated that differences among results of different investigators for the effect of month of kindling on mortality percent may be due to differences in the breed groups used, location, management, feeding systems and climatic conditions.

Preweaning litter losses was reanalysed for the effects of the same factors discussed above in addition to the fixed effect of litter size at birth. Results of the analysis suggest that preweaning litter losses increased with the increase of litter size, but the differences were not significant. Most of the Egyptian studies (Khalil, 1980; Afifi and Emara, 1984b) showed the same trend. However, the increase of preweaning mortality with the increase of litter size at birth seems to be a normal trend. This is because the increase in litter size at birth is associated with a decrease in the average individual weight in the litter at birth (Afifi et al., 1973) and with a lower share of the dams' milk during the short period of suckling (2.7 to 4.5 minutes/day, Zarrow et al., 1965) where competition for teats is greater (teat number in the doe ranges from 8 to 10, May and Simpson, 1975) and consequently the small rabbits become weak, unfit and more susceptible to death. Also, deaths due to chilling and starvation in large litters can be considered as other causes in this respect.

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