ANALYSIS OF INCIDENCE OF PRE AND POST MATURE GESTATIONS IN RABBIT POPULATIONS

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Abstract - Records of 5043 parturitions from two commercial breeds of rabbits (2724 Bauscat and 2319 New Zealand White) were analyzed to investigate the productive and reproductive traits as affected by gestational type (pre-mature, full term or post-mature). The genetic and environmental factors affecting gestation length were also studied. The total incidence of pre-and post-mature doe were 1.6 and 31 %, respectively. The incidence of overdue does were decreased as litter size at birth increased. Full term does showed a reproductive performance superior to the predate and overdue does, having a higher overall litter size and mass at birth. Estimates of paternal halfsib heritability for gestation length were very low and repeatability were found to be slightly higher. Litter size appears to be the major non-genetic factor affected on incidence of pre and post mature.

INTRODUCTION

Pre-or post-mature litters causes delivery of it earlier or later than the full term delivery time. Prematurity may be due to difficulty in extra-uterine adaptation due to immaturity of organ and instability in the different homeostatic control (GUYTON, 1981 and BEHRMAN *et al.*, 1992). The causes of prolonged pregnancy are not known in the majority of cases, but there may be hereditary or hormonal factors. However, mortality is increased with post-maturity (PARTRIDGE *et al.*, 1981 and EL DARAWANY, 1994). The information about the effects of pre-and post-maturity on production and reproductive traits of rabbits and genetic and environmental factors affecting such phenomena in rabbit populations are lacking. The objectives of the present study were to investigate the effects of incidence of such phenomena on productive and reproductive traits in Bauscat and New Zealand White breeds, and the environmental and genetic factors influencing them.

MATERIAL AND METHODS

The study was carried out in San El-Hagar Agricultural Company Farm, San El-Hagar area, Sharkeya Governorate, Egypt. The data set included two commercial rabbit breeds [Bauscat (Bau) and New Zealand White (NZW)]. The length of gestation was calculated as the number of days from second day after the day of mating to the day of kindling. Gestation length was classified to predate = < 29, full term = 30, 31 & 32 and overdue does ≥33 days. The analysis of the data included the following : gestation period, litter size and litter mass at birth, 21 days and at weaning, pre-weaning daily gain, stillbirths, pre weaning mortality and birth-to-remating interval. The data were analysed by using Mixed Model least-squares and Maximum likelihood Mean of HARVEY (1990). The following mathematical model was used to describe the pre weaning litter performance :

$$Y_{ijklmnoq} = \mu + S_i + D_{ij} + A_k + M_l + AM_{kl} + P_m + Z_n + X_0 + e_{ijklmnoq}, \text{ where}$$

$Y_{ijklmnoq}$ = observed value of a given dependent variable (Litter mass at different periods, pre weaning daily gain, and mortality rate) ; μ = overall mean ; S_j = random effect of the *ith* sire of doe ; D_{ij} = random effect of *jth* doe within *ith* sire ; A_k= fixed effect of the k*th* year at delivery (k = 1 and 2) ; M_l = fixed effect of the l*th* season at delivery, l = 1,..4 (winter, spring, summer and autumn) ; AM_{kl} = Interaction of k*th* year and l*th* season at delivery; P_m = fixed effect of the m*th* parity m = 1,..≥ 10 ; Z_n = fixed effect of the n*th* litter size at birth n = 1, ≥ 10 ; X_0 = fixed effect of the o*th* gestation length classes o = 1,.3 (1= < 29, 2 = 30, 31& 32 and 3 ≥ 33 days) and $e_{ijklmnoq}$ = random residual component. Analysis of litter size at different periods (as dependent variable) was carried out using a model including the previous random and fixed effects, except litter size at births. Analysis of gestation length (as dependent variable) was carried out using a model including the previous random and fixed effects, except gestation length classes, in addition to birth-to-remating interval, litter mass at birth or stillbirths as independent covariates. Paternal halfsib heritabilities for the gestation length were calculated. Repeatabilities were computed by the LSMLMW computer program of HARVEY (1990). The data on incidence of predate, full term and post mature were analysed using the Chi-square test according to FLEISS (1981) by using SAS PROGRAM (1990).

RESULTS AND DISCUSSION

Table 1 : Incidence % of premature, mature and postmature of total data of (Bauscat and New Zealand White) as affected by breed, year and season at birth, parity and litter size at birth.

Classification	Total Data %		
	Pre	Full	Post
Breed	1.55	67.71	30.74
Year	NS	NS	NS
First	1.60	69.76	28.64
Second	1.49	65.49	33.02
Season	*	*	*
Winter	1.18	82.10	16.81
Spring	1.42	65.37	33.21
Summer	1.89	58.31	39.80
Autumn	1.74	65.01	33.25
Parity	***	***	***
1	2.43	82.68	14.90
2	0.69	72.88	26.43
3	2.06	65.15	32.79
4	1.14	58.75	39.54
5	0.24	61.11	38.65
6	1.84	57.67	40.49
7	1.14	61.36	37.50
8	0.46	62.33	37.21
9	0.00	58.33	41.67
> 10	2.39	52.79	44.83
Litter size	***	***	***
1	2.38	27.38	70.24
2	6.99	22.04	70.97
3	2.16	52.29	45.55
4	1.71	47.44	50.85
5	2.08	55.56	42.36
6	1.08	63.44	35.48
7	1.15	69.55	29.30
8	0.94	76.14	22.92
9	0.91	85.41	13.68
>10	1.51	83.24	15.25

*** $P < 0.001$ * $P < 0.05$ NS = Non Significant
Pre = Predate Full = full term and post = overdue doe

Incidence of premature, mature and post mature as affected by some environmental factors (Table 1).

The general frequency of overdue does were 31 % for total material, while 1.6 of the delivery were predate does. The percentage of overdue does was similar to those recorded in NZW by PARTRIDGE *et al.*, I (1981). Season effects were significant ($P < 0.05$). The high incidence of predate and overdue does occurred during summer, however , low incidence of it occurred during winter in breeds studied. The high incidence of full term does occurred during winter. This might be attributed to a high variation in the ambient temperature among seasons, where it increased to a high level in summer. Premature and 'post mature litters are in general associated with malnutrition and intrauterine growth retardation of doe during pregnancy. A finding similar to that observed in rodents (JAINUDEEN and HAFEZ, 1970).

Parity effects was highly significant ($P < 0.001$). Full term does were decreased as parity increased. The high incidence predate does occurred during 1*st* and > 10*th* parities. This might be attributed to fetal conditions such as erythroblastosis, fetal distress, or poor fetal growth may require early delivery in first and late parities. The low overdue does occurred during 1*st* parity, while, they increase relatively to 4*th* an 6*th* parities. These results agree with the findings of CLOHERTY and STARK (1991) how reported that post-maturity was increase with increased parity in human.

Litter size at birth effects was highly significant ($P < 0.001$). The high incidence predate does occurred with two litter size at birth. Full term does were increased as litter size at birth increased. The incidence of overdue does were decreased as litter size at birth increased. Similar to that was reported by RODRIGUEZ *et. al.*, (1985) and EL-DARAWANY (1994).

Reproductive performance of predate, full term and overdue does (Tables 2 and 3)

The mean values observed of performance traits in two breeds were satisfactory and agree with FARGHALY (1996) for litter size and litter mass at birth, 21 days and at weaning and PARTRIDGE *et al.*, (1981) and FARGHALY *et al.*, (1994) for stillbirths and pre weaning mortality.

The litter size and mass at birth was significantly lower ($P < 0.001$) in predate and overdue does than in full term does in both Bau and NZW breeds. These results agree with the findings of RODRIGUEZ *et al.*, (1985)

Table 2 : Least-squares means (LSM) ± SE of reproductive performance of predate, full term and overdue doe in Bauscat breed

Items	Gestational age		
	Predate LSM ± SE	Full term LSM ± SE	Overdue LSM ± SE
Gestation	A	B	C
	27.44 ± 0.31	31.70 ± 0.29	33.34 ± 0.29
Litter size at:	A	B	C
Birth	5.70 ± 0.80	7.36 ± 0.72	5.68 ± 0.72
21 days	2.70 ± 1.82	5.25 ± 1.75	4.05 ± 1.75
Weaning	2.19 ± 0.53	4.66 ± 0.21	3.66 ± 0.16
Litter mass at :	A	B	C
Birth	296 ± 53	406 ± 46	334 ± 46
21 days	832 ± 266	1472 ± 227	1307 ± 228
Weaning	1220 ± 295	2649 ± 295	2273 ± 109
Preweaning	A	B	B
daily gain	7.07 ± 1.88	12.72 ± 1.26	13.20 ± 1.27
Mortality :			
	A	B	C
Stillbirths	6.8 ± 2.9	5.7 ± 1.7	7.9 ± 1.7
	A	A	A
Preweaning	20.7 ± 10.9	24.8 ± 3.6	23.6 ± 3.9

Least squares means in the same row bearing different letters, differ significantly (*** P < 0.001, ** P < 0.01 or NS Non Signifiant).

Table 3 : Least-squares means (LSM) ± SE of reproductive performance of predate, full term and overdue doe in New Zealand White breed

Items	Gestational age		
	Predate LSM ± SE	Full term LSM ± SE	Overdue LSM ± SE
Gestation	A	B	C
	26.64 ± 0.41	31.71 ± 0.38	33.38 ± 0.38
Litter size at :	A	B	C
Birth	6.19 ± 0.49	7.43 ± 0.34	5.65 ± 0.27
21 days	3.89 ± 0.84	5.59 ± 0.69	4.28 ± 0.70
Weaning	3.85 ± 0.81	5.09 ± 0.64	3.88 ± 0.65
Litter mass at :	A	B	C
Birth	318 ± 33	410 ± 24	335 ± 24
21 days	1071 ± 171	1506 ± 107	1327 ± 110
Weaning	2069 ± 286	2819 ± 86	2394 ± 97
	A	B	B
Daily gain	7.87 ± 2.29	12.65 ± 1.51	13.55 ± 1.53
Mortality :			
	A	B	C
Stillbirths %	5.1 ± 2.6	3.7 ± 1.1	6.0 ± 1.1
Preweaning	A	A	A
mortality %	20.7 ± 10.9	24.8 ± 3.6	23.6 ± 3.9

Least saquares means in the same row bearing different letters, differ significantly (*** P < 0.001, ** P < 0.01 or NS Non Significant)

for small litter size with prolonged gestation length. FARGHALY and EL-DARAWANY (1994) reported that highly significant phenotypic correlation between litter size and litter mass at birth.

The pre weaning daily gain was significantly lower (P < 0.001) in predate than overdue and full term does. The stillbirths % was significantly higher (P < 0.01) in predate and overdue does than in full term does. The highest stillbirths are related to both short and long gestation length. The higher stillbirths with shorter and longer gestation period may be the results of slightly premature births and obstructed labour, respectively (VAN DEN BROECK and LAMPO, PARTRIDGE *et al.*, 1981 and EL-DARAWANY, 1994). The difference between predate, full term and overdue does were not significant for preweaning mortality.

Fixed effects and gestation length (Table 4)

Parity, season of birth and litter size at birth significantly (P < 0.001) affected gestation length. The effect of year and its interactions with season were not significant.

Parity effect showed a gradual increase from the first to the fourth parity and stability thereafter. The effect of parity could be a physical effect and resulted from the change in body size and the physiological function of the growing doe and to the increase in nutritional supply to the foetus.

Gestation length was shortest during winter. The antagonism trends were observed during summer season. Season effects on length of gestation was noted by ASDELL (1946).

Litter size at birth was the most important factor affecting gestation length. Gestation length was decreased with the increase of litter size at birth. Such effect was noted by TEMPLETON (1939), JAINUDEEN and HAFEZ (1970) and ADAMS (1972).

Table 4 : Least-squares means and standard errors for gestation length as affected by fixed effects in Bauscat and New Zealand White breeds.

Independent	Bauscat		NZW Zealand White	
	No. obs	Least-square means ± SE	No. obs.	Least-square means ± SE
Overa ll mean	2724	31.40 ± 0.24	2319	31.42 ± 0.18
Year		NS		NS
1	1482	31.40 ± 0.24	1147	31.45 ± 0.20
2	1242	31.41 ± 0.24	1172	31.38 ± 0.20
Season		***		***
1	707	31.22 ± 0.24	566	31.19 ± 0.19
2	741	31.42 ± 0.24	671	31.41 ± 0.19
3	689	31.52 ± 0.24	580	31.60 ± 0.19
4	587	31.46 ± 0.24	502	31.46 ± 0.20
Parity		***		***
1	614	30.75 ± 0.25	581	30.93 ± 0.21
2	451	31.22 ± 0.25	423	31.35 ± 0.21
3	354	31.36 ± 0.25	326	31.36 ± 0.21
4	286	31.54 ± 0.25	240	31.33 ± 0.21
5	234	31.49 ± 0.25	180	31.59 ± 0.21
6	190	31.37 ± 0.25	136	31.42 ± 0.22
7	154	31.51 ± 0.25	110	31.61 ± 0.22
8	126	31.56 ± 0.26	89	31.53 ± 0.24
9	100	31.65 ± 0.27	72	31.60 ± 0.26
>10	215	31.58 ± 0.26	162	31.46 ± 0.24
Litter size at birth		***		***
1	50	32.12 ± 0.29	34	32.88 ± 0.31
2	105	31.96 ± 0.26	81	31.83 ± 0.24
3	209	31.51 ± 0.25	162	31.56 ± 0.21
4	168	31.58 ± 0.25	125	31.40 ± 0.22
5	212	31.42 ± 0.25	220	31.30 ± 0.20
6	321	31.30 ± 0.24	330	31.40 ± 0.20
7	404	31.17 ± 0.24	381	31.16 ± 0.19
8	469	31.11 ± 0.24	386	31.05 ± 0.19
9	373	30.90 ± 0.24	285	30.85 ± 0.20
>10	413	30.96 ± 0.24	315	30.76 ± 0.20

*** = P < 0.001 NS = Non Significant

Regression (Table 5)

The linear regression coefficients of gestation length on birth-to-remating interval or litter mass at birth were highly significant (P < 0.001) in both Bau and NZW breeds. These results show that each one day increase in birth-to-remating interval has resulted in a decrease of 0.0037 and 0.0059 % in gestation length in Bau and NZW, respectively. Estimates of linear regression of gestation length on litter mass at birth showed that gestation length increased as litter mass at birth decreased. The quadratic regression of gestation length on birth-to-remating interval, litter mass and stillbirths were not significant in both Bau and NZW breeds.

Heritability and repeatability

Paternal halfsib estimates of heritability and repeatability for gestation length are 0.10 ± 0.01 and 0.15 ± 0.04 for Bau and 0.06 ± 0.01 and 0.24 ± 0.07 for NZW. Heritability estimates of gestation length in both Bau and NZW were low. The estimates agree with FERRAZ *et al.*, (1992) on same breed of rabbits. Repeatability of gestation length were found to be slightly higher and ranged from 15 to 25 %, similar to that reported by PIRCHNER (1983) in cattle. These results suggest that selection of full term doe and against abnormal delivery time based on a single record could not be undertaken for improvement of the reproductive potential of rabbit does.

Table 5 : Regression analysis (b ± se) for gestation length on birth-to-remating interval, litter mass at birth or stillbirts

Traits #	Bauscat Linear (% / days)	Bauscat Quadratic (% / day 2)	NZW Zealand white Linear (% / gram)	NZW Zealand white Quadratic (% / gram 2)
Birth-to-remating interval	*** - 0.0037 ± 0.002	NS $1.3^{-06} \pm 5^{-05}$	** - 0.00587 ± 0.00181	NS $1.6^{-04} \pm 7^{-05}$
Litter mass at birth	*** - 0.0012 ± 0.00026	NS $-6.9^{-08} \pm 1^{-06}$	*** - 0.00112 ± 0.00027	NS $-8.6^{-07} \pm 1^{-05}$
Stillbirths	NS 0.0092 ± 0.0031	NS $-1.2^{-04} \pm 7^{-04}$	* 0.01060 ± 0.00487	NS $-1.4^{-04} \pm 1^{-04}$

*** P<0.001, ** P<0.01, * P<0.05 an NS =Non Significant

CONCLUSIONS

Pre-and post-mature are risky phenomenons in commercial rabbit population. The control of overdue does (post-mature litters) can be achieved by hormone treatments, but, environmental adjustment and indirect genetic selection has advantages, its effects are permanent, low cost in the long period and prevention negative side-effects of hormonal treatments. Litter size and their correlated traits appears to be the major non-genetic factors affecting on incidence of pre and post-mature. Improved overdue doe efficiency can be achieved by, in part, indirect selection for optimum litter size at birth for each breed. In general, optimum litter size at birth could be undertaken for improvement fitness traits in rabbits by using dynamic program.

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