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Analysis of performances in white giant rabbits reared in sub-temperate climate of Kodai hills, Tamil Nadu

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ABSTRACT : The present study was carried out at Institute Rabbit Farm of ICAR-Southern Regional Research Centre, Central Sheep and Wool Research Institute, Mannavanur, Kodaikanal, Tamil Nadu, India which is located at 2030 metre above mean sea level. The climatic conditions prevailing in the region is sub-temperate with winter temperature during night hours going below zero °C. The objective of investigation was to find out the influence of different factors such as year, season and parity on different litter traits and pre-weaning growth of White Giant rabbits in order to come out with the best strategies for improving the productivity of these rabbits. A total of 946 records for litter size at birth (LSB) and weaning (LSW), litter weight at birth (LWB) and weaning (LWW) were collected in the period between 2000 to 2009 and the data was analyzed using General Linear Model option of SAS 9.2. The overall LSB, LSW, LWB and LWW were 7.067±0.11, 5.788±0.13, 400.00±5.99g and 4.877±0.10 kg, respectively. All the litter traits varied significantly year-wise, however, they were not varying significantly parity-wise except LWW which increased progressively from first parity (4.364 ± 0.32 kg) to fifth parity (5.612 ± 0.27 kg). The season of kindling did not have significant role in affecting different litter traits and the values were comparable. The year, season and sex had significantly (P>0.01) influenced both weaning weight at six weeks and pre-weaning ADG. The growth was better in male animals as evident from higher body weight at six week age and average daily gain (853.090 ± 3.49 g and 19.123 ± 0.08 g/day vs. 820.493 ± 3.53 g and 18.347 ± 0.08 g/day). Rabbits born during winter months gained more weight (876.055 ± 4.86 g and 19.670 ± 0.12 g/day) while performance of rabbits born during spring and rainy season were comparable. The significant effects of the non-genetic factors like year of kindling on all litter traits, individual weight at weaning and pre-weaning ADG, season and parity on some of the traits are indications that any future breed development strategy must take into consideration the environment by providing additional care, feed supplementation and better shelter management to the rabbits so that the full genetic potential can be realized.

KEY WORDS : Rabbit, Sub-temperate, Litter traits, Parity, Season, Growth

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INTRODUCTION

In India, rabbit rearing is gaining momentum in the recent past, which is substantiated from the total rabbit population in India that increased from 424 thousands in 2007 to 591.6 thousands in 2012, around 39.55 per cent increase in last five years (Livestock census, 2012). There has been a rising awareness in recent years by the virtues of broiler rabbit production as an alternative means of alleviating food shortages owing to their small body size, rapid growth, high prolificacy, early maturity, shorter generation interval and ability to utilize forage and fibrous agricultural by-products (Ghosh *et al.*, 2008). Rabbit has

several advantages over many other farm species, including meat is highly digestible, wholesome, tasty, low in cholesterol, rich in sodium and high protein content (Herbert, 2011). The production efficiency of any rabbit farm depends on the number of young born alive at kindling and their survival to weaning. In addition, pre-weaning growth is an important phase in meat rabbits which ultimately decides quantum of meat produced at finisher stage (Gerencser *et al.*, 2011). According to Lazzaroni *et al.* (2012), factors such as breed, season, age and weight of females influence the reproductive performance of animals. The performance of rabbits raised in India is very limited that too mainly focusing on performance in tropical climatic condition (Ghosh *et al.*, 2008; Sivakumar *et al.*, 2013 and Pasupathi *et al.*, 2014), however, the reports on performance of rabbits in sub-temperate climate conditions of India are scanty (Kumar *et al.*, 2013). In the present study, efforts have been made to find the influence of different non-genetic factors such as year, season and parity on different litter traits and pre-weaning growth of white giant rabbits reared in sub-temperate climatic conditions of Kodai Hills, Tamil Nadu in order to advocate strategies for improving the productivity of these rabbits.

MATERIAL AND METHODS

The present study was carried out at Institute Rabbit Farm of Southern Regional Research Centre, Mannavanur, Kodaikanal, Tamil Nadu, India (2030 metre above mean sea level). Climatic conditions prevailing in the region is sub-temperate with winter temperature during night hours going below zero^{o}C with average annual rainfall 1200 to 1400 mm. During summer months, mean monthly minimum and maximum temperature ranges from 12°C to 28°C and in winter months, it ranges from sub zero to 16°C. The rabbits belonging to White Giant breed were reared in cage system. The cages are made of galvanized iron and rabbits were kept in colony upto 12 to 16 weeks of age and later on shifted to individual cages. The rabbits were provided concentrate mixture (16% crude protein and 2400 kcal metabolizable energy) at the rate of 75 g/d upto 6th wk of age (weaners) and 100 g/d from 7th to 12th wk of age (growers) and 150 g/d to the adult males in two divided doses in morning and evening. For the lactating does and kits, a concentrate mixture of 200 to 250 g/d was given, according to their body condition and litter size. In addition, rabbits were fed with green fodder (Lucerne, oats, grasses) depending on their seasonal availability in the afternoon at the rate of 250 to 300 g/animal. They were provided with clean lukewarm water *ad libitum*. Kits and does were housed together and were weaned at 42 days of age. A standard prophylactic endo- and ecto-parasitic control schedule was applied. The females were first mated at 7 to 8 months of age and a day after each weaning (43rd day after parturition) thereafter. Bucks were assigned to females for natural service as per the breeding plan of the farm, so that inbreeding could be evaded.For the present work, a total of 946 records of litter size at birth (LSB) and weaning (LSW), litter weight at birth (LWB) and weaning (LWW), weight at weaning (6 weeks age) and pre-weaning average daily gain (ADG) were collected for the period between 2000 to 2009. Each year was divided into 3 seasons, *i.e.* spring (March to June); rainy (July-October) and winter (November to February) seasons as per the long term temperature and humidity index (THI) prevailing in the region. LSB, LSW, LWB and LWW were analyzed using the following model :

$$\mathbf{Y_{jklm}=«+Y_j+S_k+P_l+e_{jklm}}$$

where, Y_{jklm} was the observed trait, μ was the population mean, Y_j was the effect of year (with 5 levels: 2000–01, 2002–03, 2004–05, 2006–07 and 2008-09), S_k was the effect of season (with 3 levels: Spring, Rainy and winter), P_l was the effect of parity of doe (with 8 levels: from 1 to 7 parities and 8 or more parities) and e_{jklm} was random error while weight at weaning and pre-weaning ADG were analyzed using :

$$\mathbf{Y_{jklm}=«+Y_j+S_k+P_l+e_{jklm}}$$

where, Y_{jklm} was the observed trait, μ was the population mean, Y_j was the effect of year (with 5 levels: 2000–01, 2002–03, 2004–05, 2006–07 and 2008–09), S_k was the effect of season (with 3 levels: Spring, Rainy and winter), P_l was the effect of sex (with 2 levels: male and female) and e_{jklm} was random error. All the interactions were found to be non-significant and hence all interactions were ignored. All analyses were performed using the Generalized Linear Model (GLM) procedure of SAS 9.2. Comparison of the means of the different subgroups was performed by Duncan's multiple range tests as described by Kramer (1957).

RESULTS AND DISCUSSION

The least square mean and SE of various litter traits like LSB, LSW, LWB and LWW are displayed in Table 1 and weight at weaning and pre-weaning ADG are given in Table 2.

Table 1 : Least square means and standard error of various litter traits in white giant rabbits

Effects	Number	Litter size at birth (No)	Litter size at weaning (No)	Litter weight at birth (g)	Litter weight at weaning (kg)
Overall mean	946	7.067±0.11	5.788±0.13	400.00±5.99	4.877±0.10
Period					
2000-01	154	6.769±0.26^{a}	5.612±0.29^{a}	395.58±13.7^{A}	4.050±0.24^{A}
2002-03	133	6.846±0.25^{ab}	5.406±0.29^{a}	422.94±13.33^{B}	4.705±0.23^{AB}
2004-05	315	7.503±0.18^{c}	5.658±0.20^{ab}	453.62±9.22^{B}	5.153±0.16^{C}
2006-07	162	7.275±0.29^{bc}	6.304±0.32^{b}	376.84±15.08^{A}	5.065±0.26^{BC}
2008-09	182	6.958±0.29^{abc}	6.021±0.33^{ab}	347.94±15.19^{A}	5.400±0.26^{BC}
Season					
Spring	277	6.991±0.21	5.743±0.24	390.85±10.96	4.796±0.19
Rainy	335	7.187±0.19	5.930±0.22	398.25±10.06	4.951±0.17
Winter	334	7.018±0.19	5.687±0.22	410.20±10.15	4.876±0.17
Parity					
First	96	6.928±0.35	5.845±0.40	388.98±18.50	4.364±0.32^{a}
Second	84	7.173±0.33	5.941±0.37	392.46±17.23	4.990±0.30^{b}
Third	86	6.929±0.35	5.914±0.39	389.48±18.23	4.933±0.31^{b}
Fourth	81	6.807±0.33	6.003±0.37	390.81±17.34	5.270±0.30^{b}
Fifth	80	7.726±0.30	6.434±0.34	428.82±15.67	5.612±0.27^{c}
Sixth	77	6.820±0.38	5.396±0.43	404.04±20.04	4.670±0.34^{ab}
Seventh	73	6.968±0.31	5.500±0.36	398.49±16.56	4.762±0.28^{ab}
8th and above	369	7.267±0.18	5.371±0.20	409.06±9.29	4.544±0.16^{ab}

Spring – March to June; Rainy – July-October; winter – November to February; Rows with different superscripts in upper case differ significantly at 1 % level; Rows with different superscripts in lower case differ significantly at b % level

Table 2 : Least square means and standard error of weaning weight (six weeks) and pre-weaning ADG in white giant rabbits

Effect	Number	Weaning weight	Pre weaning ADG
Overall mean		836.792±2.480	18.735±0.06
Period			
2000-01	819	751.645±7.51^{A}	16.708±0.18^{A}
2002-03	714	847.777±5.90^{C}	18.996±0.14^{C}
2004-05	1576	894.801±3.92^{D}	20.116±0.09^{D}
2006-07	1026	801.047±4.82^{B}	17.884±0.12^{B}
2008-09	1073	888.687±4.89^{CD}	19.971±0.12^{CD}
Season			
Spring (March to June)	1664	817.203±4.29^{A}	18.268±0.10^{A}
Rainy (July to October)	2122	817.116±3.65^{A}	18.267±0.09^{A}
Winter (November to February)	1422	876.055±4.86^{B}	19.670±0.12^{B}
Sex			
Male	2606	853.090±3.49^{A}	19.123±0.08^{A}
Female	2602	820.493±3.53^{B}	18.347±0.08^{B}

Rows with different super scripts differ significantly at 1 % level

Litter size at birth and weaning :

Litter size in rabbits is regarded as one of the most important economic traits in any breed development and improvement programmes for intensive meat production as they ultimately decide the amount of meat obtained from the pair of rabbit. In the present study, the litter size at birth and weaning was found to be 7.067±0.11 and 5.788±0.13, respectively in the White Giant rabbits. Sivakumar *et al.* (2013) recorded lower LSB and LSW of 5.1±0.1 and 4.1±0.1, respectively in White Giant rabbits reared under tropical climatic conditions of Tamil Nadu. Similarly, Kumar *et al.* (2013) also reported slightly lower LSB and LSW in white giant (5.31±0.21 and 4.72±0.22) reared under sub-temperate climatic conditions of India. The better litter size as obtained in the present study shows that the sub-temperate climate prevailing in the region is encouraging for the rabbit rearing and the animals are utilizing its genetic potential in a superior way. Litter size at weaning is an indication of the mothering ability of the doe owing to superior milk yield as kits are solely depends on it for their nutrient requirements. According to Moce and Santacreu (2010) most maternal lines are selected based on litter size at weaning, since this trait reflects both the prolificacy and mothering ability of the doe.

Year of kindling was found to significantly (P<0.01) influence litter size at birth and weaning. LSB ranged from 6.769±0.26 in 2000-01 to 7.503±0.18 in 2004-05 and LSW ranged from 5.406±0.29 in 2002-03 to 6.304±0.32 in 2006-07. This agrees with the reports by Sivakumar *et al.* (2013) and Kumar *et al.* (2006) on similar rabbit breeds. Lazzaroni *et al*. (2012) also observed that the litter size at birth and weaning were significantly varying over different years in Carmagnola Grey rabbit reared in sub-temperate climate of Italy. Apori *et al*. (2014) reported that LSW was significantly influenced by year of kindling while LSB was not affected by year effect. In contrast, Pasupathi *et al*. (2014) reported that year has no significant influence on either LSB or LSW. The variations in reproductive performance of rabbits in different years might be probably due to the differences in fodder availability and variations in management aspects followed during different years.

Litter size at birth and weaning was not significantly influenced by season of birth. Similarly, Pasupathi *et al.* (2014) and Bhatt *et al.* (2002) observed that season has no effect on LSB or LSW. Ghosh *et al.* (2008) also noted that season had no significant effect on litter size at birth (6.35±0.62) or at weaning (5.39±0.58) on the rabbits reared in sub-tropical climate. However, Kumar *et al.* (2006) reported a non-significant effect of season on litter size at birth for foreign rabbit breeds (Soviet Chinchilla, White Giant and New Zealand White) kept in the high altitude conditions of Tamil Nadu while LSW was significantly differing in various seasons. Kumar *et al.* (2013) observed that LSW was affected by season of birth.

In the present study, parity did not have a significant effect on LSB and LSW. Kumar *et al*. (2013) and Sivakumar *et al.* (2013) also noted that LSB and LSW did not differ due to parity of the animal. In contrast, Xiccato *et al.* (2004) and Apori *et al.* (2014) recorded that parity was found to have significantly influenced the litter size at birth and weaning. Lebas *et al.* (1997) reported that litter size increases by 10 to 20 per cent from the first to the second litter and then again, but by less, from the second to the third, with no change from the third to the fourth and after the fourth, the size may decrease.

Litter weight at birth and weaning :

The litter weight at birth and weaning was found to be 400 ± 5.99 g and 4.877±0.10 kg, respectively in the White Giant rabbits. Sivakumar *et al.* (2013) in their study recorded lower LWB and LWW of 259.6±6.1 g and 2432.6±68.7 g, respectively in White Giant rabbits reared under tropical climatic conditions of Tamil Nadu. Kumar *et al.* (2013) also reported slightly lower LWB and LWW in White Giant (297.33±14.41 g and 3.79±0.18 kg) and Soviet Chinchilla (303.22±20.9 g and 4.24±0.23 kg) reared under sub-temperate climatic conditions of India.

The year had significant (P < 0.01) influence on both LWB and LWW. LWB ranged from 395.58±13.7 g in 2000-01 to 453.62±9.22 g in 2004-05 and LWW ranged from 4.050±0.24 kg in 2000-01 to 5.400±0.26 kg in 2008-09. Pasupathi *et al.* (2014) inferred that the year effect was significantly influencing both the traits *viz.*, birth weight and weaning weight of individuals which can be attributed to the factor that the availability of good quality roughage feed during the year. Sivakumar *et al.* (2013) and Sood *et al.* (2006) also observed a significant effect of year of birth on litter weight at birth and weaning. The season of kindling did not have significant role in affecting different litter traits and the values were comparable. In contrast, Sivakumar *et al.* (2013) and Sood *et al.* (2006) observed that LWB and LWW were influenced by season

of kindling. They inferred that the lower litter weight at birth during summer season could be due to the limited availability of good quality green forage to the females. Kumar *et al.* (2013) noted that LWB is not influenced by season while LWW is differing significantly over various seasons.

In the present study, parity had significant influence on LWW. LWW increased progressively from first parity (4.364±0.32 kg) to fifth parity (5.612±0.27 kg). Sivakumar *et al.* (2013) also observed that parity had a significant effect (P<0.01) on litter weight at weaning in White Giant and Soviet Chinchilla breeds and it increased with parity order. This is in agreement with increase in milk production as parity order advanced (Maertens *et al.*, 2006). The lower LWB and LWW in first parity animals as observed in present study is due to the fact that earlier-parity animals continue to grow until reaching adult size and compete with the foetuses for available nutrients during pregnancy. Again, increased birth weight with increased parity is an indication of older dams' ability to utilize feed more efficiently to support foetal development than younger ones as reported by Aksakal and Bayram (2009) in cows. Xiccato *et al.* (2004) and Apori *et al.* (2014) found a significant effect of parity on litter weight at birth as well as litter weight at weaning, while Das and Yadav (2007) found that parity influenced the litter weight at birth significantly which was higher in the 3rd parity than in the 1st and the 2nd parity. Kumar *et al.* (2013) reported that litter traits were not significantly influenced by parity, however, litter size and weight at birth as well as litter size at weaning increased with advancing parity.

Weaning weight (6 weeks age) and pre-weaning ADG :

The overall weaning weight and pre-weaning ADG in the present study was found to be 836.79±2.48 g and 18.735±0.06 g per day, respectively. The year, season and sex had significantly (P>0.01) influenced both weaning weight at six weeks and pre-weaning ADG. The growth was better in male animals as evident from higher body weight at six week age and average daily gain (853.090±3.49 g and 19.123±0.08 g/day vs. 820.493±3.53 g and 18.347±0.08 g/day). In the present study, rabbits born during winter months gained more weight (876.055±4.86 and 19.670±0.12) while performance of rabbits born during spring and rainy season were comparable. Ghosh *et al.* (2008) also reported that season of birth had a significant (P<0.01) effect on the individual body weight at weaning and observed that rabbit born during the winter and rainy seasons attained a significantly (P<0.01) higher body weight than an animal born during the summer season. The seasonal effect upon the early growth performance of rabbits was also reported by Khalil and Mansour (1987) and Kumar *et al.* (2001). The difference associated with the kindling season can be attributed to the prevalent environmental conditions and to stress factors affecting feed intake (Eberhart, 1980).

Sivakumar *et al.* (2013) observed a lower weaning weight and pre weaning ADG of 614.6 g and 13.4 g per day. Better litter weight and individual weight at six week age as observed in present study might be due to conducive environmental conditions prevailing the region. The thermo neutral zone for rabbit is between 15 to 25°C and rabbits are much more tolerant to low temperature than high temperature and perform optimum in this range of temperature (Cervera and Carmona, 1998).

Conclusion :

Better productive and reproductive performance as observed in present study in terms of higher litter size and weight at birth and weaning as well as higher weight at six weeks of age and average daily gain might be due to conducive environmental conditions prevailing in the region and THI in the region during majority of the period falls under thermo neutral zone of the species and also due to availability of good quality lush pasture/ fodder. The significant effects of the non-genetic factors like year of kindling on all litter traits, individual weight at weaning and pre weaning ADG, season and parity on some of the traits are indications that any future breed development strategy must take into consideration the environment by providing additional care, feed supplementation and better shelter management to the rabbits so that the full genetic potential can be realized.

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