

FACTORS INFLUENCING LITTER TRAITS AND BODY WEIGHT UPTO 12 WEEKS AMONG TEMPERATE RABBIT BREEDS IN HUMID TROPICS

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ABSTRACT : High prolificacy and fast growth rate make rabbit an ideal meat animal for the developing countries. Present investigation was aimed at analysing the prolificacy and growth rate among temperate breeds of rabbits namely, New Zealand White, Grey Giant and Soviet Chinchilla, under humid tropics of Kerala, India. The effects of breed and sire on litter traits and the effects of breed, sire and sex on body weight traits were analysed. Data from 172 kindlings showed an average litter size at birth of 4.38 and litter weight at birth of 228 g. Breed effects were significant ($P < 0.05$) on litter size and litter weight at weaning. The highest litter size at

weaning was obtained in Grey Giant (1.96), followed by New Zealand White (1.87) and the lowest in Soviet Chinchilla (1.18). The litter weights at weaning were 1084, 1074 and 708 g for Grey Giant, New Zealand White and Soviet Chinchilla, respectively. Pre-weaning mortality was found to be modulated by breed to a significant level ($P \leq 0.05$) with New Zealand White having the lowest pre-weaning mortality. Body weights at six weeks and twelve weeks averaged 612 g and 1168 g, respectively. Body weight at 12 weeks of age was significantly ($P < 0.05$) influenced by sire. The effects of breed and sex on body weight traits was found to be non-significant.

RÉSUMÉ : Facteurs influençant les caractéristiques de la portée et le poids vif jusqu'à 12 semaines chez des lapins de races "tempérées" élevés en milieu tropical humide.

Sa forte prolificité et sa grande vitesse de croissance font du lapin l'animal idéal pour la production de viande dans les pays en voie de développement. Cette étude analyse la prolificité et la vitesse de croissance en climat tropical humide du Kérala en Inde, de races classiquement utilisées sous climat tempéré, telles que Néo-Zélandais Blancs (NZB), Géant Gris (GG) et Chinchilla Soviétique (CS). Les effets de la race et du père sur les caractéristiques de la portée, puis ceux de la race, du père et du sexe sur les poids vifs, ont été analysés. Les données provenant de 172 mise bas montrent

une taille de portée moyenne à la naissance de 4,38 lapereaux pour un poids moyen de 228 g. Les effets de la race sont significatifs ($P < 0,05$) sur la taille de la portée et son poids au sevrage. Les tailles de portée au sevrage sont les suivantes : GG 1,96 - NZB 1,87 et CS 1,18. Les poids de portées au sevrage sont 1084, 1074 et 708 g pour les 3 races respectivement. La mortalité avant sevrage est influencée par la race à un niveau significatif ($P \leq 0,05$), les NZB ayant la plus basse. Les poids vifs moyens à 6 et 12 semaines sont respectivement de 612 et 1168 g. Le poids vif à 12 semaines est significativement influencé ($P \leq 0,05$) par le père; mais les effets de la race et du sexe sur les poids vifs ne sont pas significatifs.

INTRODUCTION

High prolificacy and fast growth make rabbit an ideal animal for meat production in developing tropics. However this optimism remains unfulfilled mostly due to poor acclimatisation of temperate rabbit breeds in tropics. The humid tropical climate contributes substantial stress on temperate breeds of rabbits that adversely affect their performance. The litter performance reported from temperate regions of the world with an average litter size at birth of 9.5 resulting in 45-50 kits per doe per year with each bunny reaching a slaughter weight of 2 kg at 8 weeks of age (KOEHL, 1995), have failed to materialise in the tropics. Reports from tropics revealed a litter size at birth of 4-6 among different rabbit breeds (RASTOGI, 1988; MUKUNDAN *et al.*, 1993) and litter size at weaning averaged 3.4 (RAJADEVAN *et al.*, 1987; RASTOGI, 1988) possibly due to heavy pre-weaning mortality as high as 60 per cent.

Body weight at six weeks among broiler rabbits averaged 610 g under tropical climate (MUKUNDAN *et al.*, 1993) while it was 1009 g under temperate climate (SLAVINSKI and ASIANS, 1988). Breed and sire effects on body weight at weaning were reported to be non-

significant (RADHAKRISHNAN, 1992). The body weight at 12 weeks among New Zealand White rabbits averaged 2275 g under temperate climate (GROBNER *et al.*, 1985).

Kerala state situated in South West India has an ambient temperature ranging from 29 – 36°C, humidity of 58 - 88% and an average rainfall of 338 cm. The stress on broiler rabbit production due to tropical climate could be augmented in the humid tropics which imposes severe thermal stress. The present investigation was under taken to assess the litter performance and body weights at weaning (six weeks) and at twelve weeks among broiler rabbit kits and to analyse the genetic factors influencing these traits among temperate breeds of broiler rabbits under humid tropical climate of Kerala.

MATERIALS AND METHODS

A pure breeding experiment utilising New Zealand White, Grey Giant and Soviet Chinchilla breeds of rabbits maintained at Centre for Advanced Studies in Animal Genetics and Breeding of Kerala Agricultural University was carried out during October 97 to June 1998. A total of 172 kindlings obtained from 34 New

Table 1 : Least-squares means for the effect of breed and sires within breed on litter traits and preweaning mortality among broiler rabbits, and corresponding probabilities.

Classes	n	Litter size at birth Mean ± SE	Litter weight at birth (g) Mean ± SE	Litter size at weaning Mean ± SE	Litter weight at weaning (g) Mean ± SE	Preweaning mortality (%) Mean ± SE
Overall mean Breed	172	4.38 ± 0.16 (<i>P</i> =0.7556)	228 ± 8.2 (<i>P</i> =0.7343)	1.67 ± 0.13 (<i>P</i> =0.0362)	955 ± 79 (<i>P</i> =0.0470)	60.0 ± 2.2 (<i>P</i> =0.0387)
New Zealand White	54	4.24 ± 0.29	220.9 ± 14.4	1.87 ± 0.23	1074 ± 139	67.7 ± 3.8
Grey Giant	47	4.55 ± 0.30	236.7 ± 14.9	1.95 ± 0.25	1084 ± 149	70.9 ± 4.1
Soviet Chinchilla	71	4.35 ± 0.26	226.0 ± 12.9	1.18 ± 0.20	708 ± 121	84.9 ± 3.4
<i>Sires within breed</i>	29	(<i>P</i> = 0.395)	(<i>P</i> = 0.6012)	(<i>P</i> = 0.6854)	(<i>P</i> = 0.5885)	(<i>P</i> = 0.7354)

Zealand White, 47 Grey Giant and 71 Soviet Chinchilla rabbit does were utilised in the present study. All animals were maintained under identical feeding and management conditions. Rabbits were housed indoors in wire mesh cages (60 x 80 x 45 cm) individually. Concentrate ration containing 20 per cent crude protein and Guinea grass were fed *ad libitum*.

Litter size and litter weight at birth, litter size and litter weight at weaning and pre-weaning mortality were recorded. The mortality percentage was subjected to Sin^{-1} transformation. Data were subjected to least squares analysis (Harvey, 1985) to ascertain the effects of breed and sire on litter traits using the following statistical model,

$$Y_{ijk} = \mu + b_i + S_j + e_{ijk}$$

where,

- Y_{ijk} Observation on k^{th} litter from j^{th} sire in i^{th} breed)
 μ Overall population mean,
 b_i effect of i^{th} breed,
 $b:s_j$ effect of j^{th} sire nested within breed
 e_{ijk} random error

Of the 172 kindlings, 113 rabbits belonging to different breeds were maintained upto 12 weeks of age and body weights at weaning (six weeks) and at 12 weeks were recorded. The data were subjected to least squares analysis (HARVEY, 1985) to assess the effect of breed, sire and sex on body weights at six weeks and at 12 weeks. The statistical model used was

$$Y_{ijkl} = \mu + b_i + S_j + S_{ek} + e_{ijkl}$$

where,

- Y_{ijkl} = body weight of l^{th} rabbit of k^{th} sex of j^{th} sire in the i^{th} breed,
 μ = over all population mean
 b_i = effect of i^{th} breed
 $b:s_j$ = effect of j^{th} sire nested within i^{th} breed
 S_{ek} = effect of k^{th} sex and
 e_{ijkl} = random error

RESULTS

Litter size at birth averaged 4.38. Least squares means for the effect of breed and sire on litter size and litter weight at birth, litter size and litter weight at weaning and pre-weaning mortality are documented in Table 1. Breed and sire showed non-significant effect on litter size and litter weight at birth. At weaning three breeds differed significant ($P \leq 0.05$) in litter size and litter weight. Grey giant showed the highest litter size at weaning (1.95) followed by New Zealand White (1.87) and the lowest litter size at weaning was shown by Soviet Chinchilla (1.18). The effects of sire on litter size and litter weight at weaning was not found to be significant. Grey Giant weaned heaviest litters with a mean of 1084 g followed by New Zealand White (1074g) and the lowest litter weight was shown by Soviet Chinchilla (708 g).

Pre-weaning mortality averaged 76.2 per cent and it differed significantly ($P \leq 0.05$) among the 3 breeds studied. New Zealand White showed the lowest pre-weaning mortality of 67.7 per cent and Soviet Chinchilla had the highest pre-weaning mortality of 84.9 per cent. The effect of sire on pre-weaning mortality was not significant.

Body weight at six weeks averaged 607g. Least squares means for the effects of breed, sire and sex on body weights at six weeks and at twelve weeks are presented in Table 2. The effects of breed, sire and sex on body weights were not significant except the effect of sire on body weight at 12 weeks of age, which was significant ($P \leq 0.05$). At 12 weeks of age, body weight averaged 1164g. Soviet Chinchilla rabbits showed the heaviest body weight at 12 weeks (1238g) followed by New Zealand White (1133 g) and Grey Giant (1121 g), while the first breed showed the lowest body weight at weaning. The effect of sire on body weight at 12 weeks was significant ($P \leq 0.05$).

Table 2 : Least-squares means for the effect of breed, sire and sex on body weight traits among broiler rabbits, and probability of the effects of breed, sex and sire.

Classes	n	Body weight at weaning (g) Mean ± SE	Body weight at 12 weeks (g) Mean ± SE
Overall means	113	607.0 ± 14.3	1163.9 ± 26.7
<i>Breed effect probability</i>		(<i>P</i> = 0.08)	(<i>P</i> = 0.09)
New Zealand White	46	614 ± 14	1133 ± 42
Grey Giant	30	642 ± 25	1121 ± 45
Soviet Chinchilla	37	564 ± 24	1238 ± 45
<i>Sex effect probability</i>		(<i>P</i> = 0.115)	(<i>P</i> = 0.47)
Male	73	629 ± 17	1179 ± 30
Female	40	586 ± 22	1149 ± 36
<i>Sire effect probability</i>		(<i>P</i> = 0.24)	(<i>P</i> = 0.035)

DISCUSSION

Litter size at birth obtained in the present study compares well and is in agreement with the value of 4.4 reported by RASTOGI (1988) from tropics, though substantially lower than the value of 9.5 reported by KOEHL (1995) from temperate climate. The reports of MUKUNDAN *et al.* (1993) and GURMEJ SINGH (1998) from Indian tropics substantiate the absence of significant effect of breed and is in agreement with the present study. The non-significant effect of sire on litter size at birth has also been reported by YAMANI *et al.* (1994) and they postulated that litter size at birth as an attribute of dam.

Litter weight at birth of 228g obtained in the present study was lower than the value reported by MUKUNDAN *et al.* (1993) and GURMEJ SINGH (1998) from Indian tropics. The lowered litter weight at birth in the current study might be possibly due to the high ambient temperature prevalent during the period of study. The non significant effect of breed on litter weight at birth is in conformity with the reports of GURMEJ SINGH (1998). The absence of sire effects on litter weight at birth has been endorsed by the reports YAMANI *et al.* (1994) who clearly demonstrated that contribution to the variance is more from dams within sires than between sires.

The litter size at weaning was substantially lower in the present study than the values reported by KOEHL (1995) in the temperate climate. The results of present study were suggestive of the effect of humid tropical stress on pre and post-natal survivability of the rabbits, lowering the litter sizes at birth and at weaning. New Zealand White and Grey Giant had a comparable litter size at weaning, while Soviet Chinchilla had a significantly low litter size at weaning of 1.18. The lowered survivability of Soviet Chinchilla rabbits under the humid tropical climate of Kerala is in

agreement with the reports of MUKUNDAN *et al.* (1993). The significant effect of breed on litter size at weaning obtained in the present study is in agreement with the reports of KHALIL *et al.* (1995). The non significant effects of sire on litter size and litter weight at weaning obtained in the present study are in concordance with the reports of YAMANI *et al.* (1994).

The heavy pre-weaning mortality of 76 per cent obtained in the present study is comparable to the reports of RAJADEVAN *et al.* (1987) from the humid Sri Lanka tropics, though the mortality rates from arid tropics were comparatively low (BHASIN and SINGH, 1995). The present study could show

the superiority of New Zealand White and Grey Giant in the pre-weaning survivability. The effect of breed on pre-weaning mortality was significant and Soviet Chinchilla showed the highest mortality. This finding is in conformity with the reports of MUKUNDAN *et al.* (1993) and GURMEJ SINGH *et al.* (1997). The non significant effect of sire on pre-weaning mortality obtained in the present study is in agreement with the report of FARGHALY (1996).

The body weight at weaning observed in the present study concurs with the values reported by RADHAKRISHNAN (1992) and MUKUNDAN *et al.* (1993) in the same breeds under humid tropics of Kerala but are much lower than the values reported by SLAVINSKI and ASIAS (1988) in temperate climate. The non significant effect of sire on body weight at weaning is in agreement with the reports of MC REYNOLDS (1974). The non significant association of body weight at weaning with sex is similar to the findings of EL-MAGHAWRY (1993).

The body weight at 12 weeks obtained in the present study is in agreement with the observations of OPUKU and LUKEFAHR (1990) and RADHAKRISHNAN (1992) under tropical conditions. The non significant effect of breed on body weight at 12 weeks have been reported by RADHAKRISHNAN (1992). The significant effect of sire on body weight at 12 weeks is in conformity with the studies of KHALIL *et al.* (1987) and RADHAKRISHNAN (1992) who concluded that sire effects were significant on adult body weights among broiler rabbits. The non significant effect of sex on body weight at 12 weeks agrees with the observations of EL-MAGHAWRY (1993).

Month wise temperature humidity index (THI) from the humid tropics of Kerala is presented in Figure 1. Maximum temperature reached to 36.27°C during March. From October onwards, the temperature rose from 31.15°C to 36.27°C in March. During April

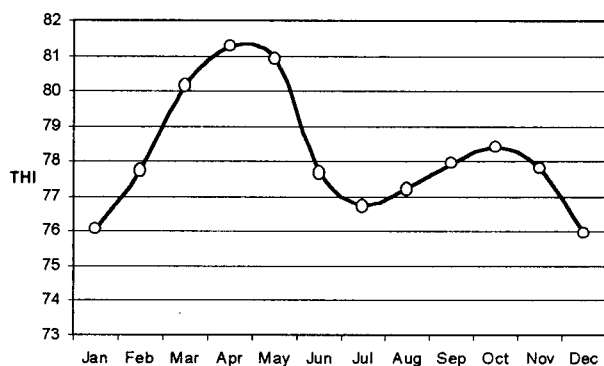


Figure 1 : Monthwise Temperature Humidity Index (THI) at Mannuthy, Kerala state, India

and May, the maximum temperatures recorded were 35.49°C and 33.69°C. The ambient temperature of above 30°C have been found to induce thermal stress in rabbits. The THI in October was 78.41. Though it dipped to 76.06 in January, from January onwards it began to increase continuously reaching 80.19 in March, 81.26 in April and 80.9 in May. This high ambient temperature and elevated THI might have induced thermal stress in temperate rabbit breeds leading to lowered litter size at birth, heavy pre-weaning mortality and subsequent lowered litter size at weaning.

CONCLUSIONS

Comparative litter performance of temperate broiler rabbit breeds was found to be much lower under humid tropical climate of Kerala than temperate regions of the world. The broiler breeds of rabbits evolved under temperate climate failed to perform optimally and as such found to be unsuitable for commercial exploitation in this climatic zone. New Zealand White rabbits had significantly lower pre-weaning mortality and this finding is of value in selecting suitable breed and breed combinations for the state.

Body weight values at weaning and at 12 weeks obtained in the present investigation under humid tropical climate of Kerala were much lower than those reported in temperate regions of the World, suggestive of a growth depressant effect of humid tropical stress on temperate broiler breeds of rabbits. Effect of sire on body weight at 12 weeks was significant, demonstrating the underlying strong genetic variation of this trait, which could be exploited in commercial broiler rabbit production.

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