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ANALYSIS OF PRODUCTION AND REPRODUCTION PERFORMANCES OF SOVIET CHINCHILLA AND WHITE GIANT RABBITS IN TROPICAL CLIMATIC CONDITIONS OF INDIA

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Abstract: The aim of the present study was to analyse the influence of year, season and parity on productive and reproductive performances in 110 Soviet Chinchilla and 64 White Giant rabbits under tropical climatic conditions of Tamil Nadu in the period between 2005 and 2009. A total of 731 records for the overall least-squares means for litter size at birth and weaning, litter weight at birth and weaning, average weight of kit at birth and weaning and pre-weaning growth rate in Soviet Chinchilla rabbits were 5.1±0.1, 3.7±0.1, 256.4±6.9 g, 2465.4±73.6 g, 50.4±0.7 g, 694.1±13.1 g and 15.3±0.3 g/d, respectively, and the values for White Giant rabbits were 5.1±0.1, 4.1±0.1, 259.6±6.1 g, 2432.6±68.7 g, 50.8±0.4 g, 614.6±13.5 g and 13.4±0.3 g/d, respectively. Breed had significant effect on litter size at weaning (*P*<0.01), average weight of kit at weaning (*P*<0.05) and pre-weaning growth rate (*P*<0.01). Year of birth had significant effect on litter size and litter weight at birth (*P*<0.05), litter size and litter weight at weaning (*P*<0.01), average weight of kits at weaning and pre-weaning growth rate (*P*<0.01) in Soviet Chinchilla and White Giant rabbits. Season of birth had significant effect on litter weight at birth and weaning (*P*<0.05), average weight of kits at birth (*P*<0.05) and weaning (*P*<0.01) and pre-weaning growth rate (*P*<0.01) in both the breeds. Parity had significant effect on litter weight and average weight of kits at weaning (*P*<0.01) and pre-weaning growth rate (*P*<0.01). The study revealed that the Soviet Chinchilla and White Giant breeds performed well in the tropical climatic conditions of Tamil Nadu and could be used for profitable meat production. The significant influence of factors such as year of birth and season of birth observed on different production traits emphasises the role played by the management in optimising the realisation of genetic potential under local agro-climatic conditions.

Key Words: rabbit, White Giant, Soviet Chinchilla, litter size, litter weight.

INTRODUCTION

Rabbits have potential as a meat producing animal in the tropics, particularly on subsistence-type farms. Rabbits are becoming increasingly popular as an additional source of animal protein to meet the increasing demand from the ever-growing human population. Rabbit rearing has gained momentum in the recent past among the developing countries including India, owing to their small body size, rapid growth, high prolificacy, early maturity, shorter generation interval and ability to utilise forage and fibrous agricultural-by products (Ghosh *et al.*, 2008). Rabbit meat is relatively rich in protein and low in fat, comprising 60% unsaturated fatty acids. In addition, rabbit meat is highly digestible and rich in omega-3 fatty acids, often recommended by nutritionists over other meats (McCroskey, 2000). Because of these favourable factors, rabbit can play a crucial role in mitigating the chronic shortage of meat in developing countries. The production efficiency of commercial rabbitries 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 and has an important bearing on the meat produced at finisher stage (Gerencsér *et al.*, 2011). The prolificacy and growth rate seem to be affected by different factors such as year, season, sex and parity (Lazzaroni *et al.*, 2012). The Soviet Chinchilla and White Giant are 2 foreign breeds of rabbits developed for meat and pelt production (Anon., 2010) in India. These 2 breeds are reared in different agro-climatic zones of India. However, there is a lack

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of information on the productive and reproductive efficiency of Soviet Chinchilla and White Giant breeds under the tropical climatic conditions of Tamil Nadu, as well as India. Therefore, the present study was undertaken to analyse the influence of year, season and parity on the production and reproduction performances of Soviet Chinchilla and White Giant breeds, in order to propose new strategies for improving the productivity of meat rabbits under tropical climatic conditions.

MATERIALS AND METHODS

This study was carried out with animals from Soviet Chinchilla and White Giant breeds. All animals were reared at the Livestock Farm of the Veterinary College and Research Institute, Namakkal, Tamil Nadu, India. The climate is generally hot, semi-arid and tropical in nature with an average annual rainfall of 907 mm. The mean annual minimum and maximum temperatures were 19.66 and 37.02°C respectively. The rabbits were individually kept in standard galvanised iron cages and provided with similar housing and management throughout the study period. In the morning, concentrate mixture (16% crude protein and 2400 kcal metabolizable energy) was given at the rate of 75 g/d up to 6th wk of age and 100 g/d from 7th to 12th wk of age. For the lactating does and kits, a concentrate mixture of 200 to 250 g/d was given, according to their body and litter size. In addition, they were fed with green fodder *viz*. hedge lucerne *(Desmanthus virgatus)* in the afternoon at the rate of 250 to 300 g/animal, according to their body size. They were provided with clean lukewarm water *ad libitum*. Kits and does were housed together up to weaning (i.e., 42 d). A standard prophylactic endo- and ecto-parasitic control schedule was applied. The Soviet Chinchilla (n=110) and White Giant females (n=64) were first mated at 7 to 8 mo of age and 42 d after each parturition thereafter. Bucks started their reproductive lives at 8 mo of age and were randomly assigned to females for natural service. Mating of close relatives was avoided to reduce inbreeding. A total of 731 records for litter size at birth and weaning, litter weight at birth and weaning, average weight of kits at birth and weaning and pre-weaning growth rate were collected in the period between 2005 and 2009. Each year was divided into 4 seasons, i.e. winter (December to February), summer (March to May), south-west monsoon (June to August) and north-east monsoon (September to November) seasons. All traits were analysed using the following model: $Y_{ijklm}=\mu+B_i+Y_j+S_k+P_l+e_{ijklm}$, where Y_{ijklm} was the observed trait, μ was the population mean, B_i was the effect of breed (with 2 levels: Soviet Chinchilla and White Giant breeds), Y_i was the effect of year (with 5 levels: from 2005 to 2009), S_k was the effect of season (with 4 levels: winter, summer, south-west monsoon and north-east monsoon), P_k was the effect of parity of doe (with 6 levels: from 1 to 5 parities and 6 or more parities) and e_{ijklm} was random error. This model was used to explore the differences between Soviet Chinchilla and White Giant breeds. Thereafter, the data from Soviet Chinchilla and White Giant breeds were analysed separately with the former model but without the breed effect. All the interactions were found to be non-significant and hence all interactions were ignored. All analyses were performed using the generalised linear model (GLM) procedure of SAS. Comparison of the means of the different subgroups was performed by Duncan's multiple range tests as described by Kramer (1957).

RESULTS AND DISCUSSION

Litter size at birth and weaning

Litter size in rabbits is considered one of the most important economic components in intensive meat production. Most of the maternal lines are selected based on litter size at weaning, since this trait reflects both the prolificacy and the milking and nursing ability of the doe (Mocé and Santacreu, 2010). The least-squares means of litter size at birth and weaning in Soviet Chinchilla and White Giant breeds are presented in Tables 1 and 2, respectively. In this study there was no significant difference in litter size at birth between breeds. This is in accordance with the findings of Rathore *et al.* (2000), Das *et al.* (2001) and Kumar *et al.* (2006) in Soviet Chinchilla and White Giant breeds maintained in different agro-climatic zones of India. In addition, Ghosh *et al.* (2008) reported a non-significant effect on litter size at birth in Soviet Chinchilla and New Zealand White rabbits kept in sub-tropical condition of India. We observed a significantly lower litter size at weaning in Soviet Chinchilla females than in New Zealand White females (3.7 *vs.* 4.1 kits; $P< 0.01$). In this regard, Marykutty and Nandakumar (2000) also reported a non-significant effect on litter size at birth in Grey Giant, Soviet Chinchilla and New Zealand White rabbits but a significant ($P<0.05$) effect on litter size at weaning in the hot and humid tropical conditions of India.

Table 1: Least squares means (±standard error) production and reproduction performances of Soviet Chinchilla rabbits.

Effects	No.	Litter size at birth	Litter size at weaning	Litter weight at birth (g)	Average weight of kit at birth (g)	Litter weight at weaning (g)	Average weight of kit at weaning (g)	Pre-weaning growth rate (g/d)
Overall	377	5.1±0.1	3.7±0.1	256.4 ±6.9	50.4 ±0.7	2465.4 ±73.6	694.1±13.1	15.3±0.3
Year								
2005	72	5.7±0.2[c]	4.8±0.2[c]	283.7±12.0[b]	49.9±1.2	2904.2±126.7[d]	625.4±22.2[a]	13.7±0.6[a]
2006	97	5.2±0.2[b]	3.9±0.2[b]	266.1±9.8[b]	51.1±1.0	3215.4±105.4[e]	858.8±19.1[d]	19.2±0.5[d]
2007	94	4.8±0.2[a]	3.4±0.2[a]	253.5±10.1[ab]	52.6±1.0	2215.4±112.0[c]	706.6±20.3[c]	15.6±0.5[c]
2008	99	4.9±0.2[a]	3.2±0.2[a]	243.4±10.2[a]	50.2±1.2	2053.6±109.4[a]	667.6±19.4[b]	14.7±0.5[b]
2009	15	4.9±0.5[a]	3.3±0.5[a]	235.6 ±26.1[a]	48.2±2.6	1938.5±282.5[a]	612.2±50.2[ab]	13.4±1.3[a]
P-value		<0.05	<0.01	<0.05		<0.01	<0.01	<0.01
Season								
Winter	88	5.2±0.2	3.7±0.2	267.0±11.4[b]	51.1±1.1[b]	2182.3±118.2[a]	634.0±21.2[a]	13.9±0.5[a]
Summer	95	5.1±0.2	3.6±0.2	233.1±11.4[a]	45.9±1.1[a]	2474.1±121.3[b]	698.3±21.1[b]	15.5±0.5[b]
South-west monsoon	80	5.0±0.2	3.7±0.2	255.0±12.1[ab]	50.5±1.2[b]	2676.4±132.8[c]	745.8±23.2[c]	16.6±0.6[c]
North-east monsoon	114	5.0±0.2	3.8±0.2	270.7±11.2[c]	53.9±1.0[c]	2529.2±113.4[b]	698.3±20.4[b]	15.3±0.5[b]
P-value				<0.05	<0.01	<0.05	<0.01	<0.01
Parity								
1st	110	5.5±0.2	4.1±0.2	269.1±10.2	48.6±1.0	2253.8±107.6[a]	572.5±19.2[a]	12.5±0.5[a]
2nd	75	5.2±0.2	3.8±0.2	259.2±12.1	50.2±1.2	2346.3±128.8[b]	655.2±23.1[b]	14.4±0.6[b]
3rd	56	5.2±0.3	3.8±0.2	262.2±13.3	50.6±1.3	2730.5±144.1[e]	709.0±25.2[c]	15.7±0.6[c]
4th	40	4.9±0.3	3.5±0.3	240.3±15.1	49.2±1.5	2427.5±165.6[c]	708.7±29.1[c]	15.7±0.7[c]
5th	29	5.0±0.4	3.6±0.3	262.9±18.2	53.1±1.8	2524.8±194.8[d]	735.7±34.0[c]	16.3±0.9[c]
≥6th	67	4.8±0.3	3.4±0.2	245.1±13.2	51.2±1.3	2509.6±137.2[d]	783.5±24.0[d]	17.4±0.6[d]
P-value						<0.01	<0.01	<0.01

Winter: December to February. Summer: March to May. South-west monsoon: June to August. North-east monsoon: September to November. Means bearing same superscript at each column and trait do not differ significantly at $P<0.05$.

The mean litter size at birth and weaning observed in Soviet Chinchilla and White Giant breeds was similar to those found by Laxmi *et al.* (2009) under the tropical climatic conditions of Andhra Pradesh, India. However Kumar *et al.* (2006) reported almost 1.5 fewer kits at birth and weaning in the same breeds under the high altitude condition of Tamil Nadu, India. Conversely, other authors have found almost 2 more kits at birth and weaning in these breeds, either at high altitude and tropical climatic or in hot and humid climatic conditions in India (Das and Nayak, 1991; Gulyani, 2001; Ghosh *et al.*, 2006; Das and Sikka, 2007; Ghosh *et al.*, 2008)

Year of birth had a significant effect ($P<0.05$) on litter size at birth and weaning in both breeds, in agreement with the report by Sood *et al.* (2006) on Angora rabbits. The season of birth had no significant effect on litter size at birth and weaning in Soviet Chinchilla breed, although it had a significant effect ($P<0.01$) on litter size at weaning in White Giant breed. The highest and lowest litter size at weaning was observed in winter and summer seasons, respectively, and they differed significantly ($P<0.05$) with other seasons. 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. Parity had no significant effect on litter size at birth and weaning in both studied breeds. However, other authors have reported almost 0.5 kits more in the first parity than in the rest in the sub-temperate condition of India (Umesh Singh *et al.,* 2007).

There was no difference in the gestation period among the breeds (32.7±0.1 d in Soviet Chinchilla *vs.* 32.4±0.1 d in White Giant rabbits). Kumar *et al.* (2006) reported a comparable gestation period of 32.9±0.1 d for the Soviet Chinchilla, White Giant and New Zealand White rabbits reared in the high altitude conditions of Tamil Nadu. A non-significant effect of genetic group on gestation period was also described by Das *et al.* (2001).

Table 2: Least squares means (±standard error) production and reproduction performances of White Giant rabbits.

Effects	No.	Litter size at birth	Litter size at weaning	Litter weight at birth (g)	Average weight of kit at birth (g)	Litter weight at weaning (g)	Average weight of kit at weaning (g)	Pre-weaning growth rate(g/d)
Overall	354	5.1±0.1	4.1 ±0.1	259.6±6.1	50.8 ±0.4	2432.6±68.7	614.6±13.5	13.4±0.3
Year								
2005	80	5.4±0.2^{b}	4.6 ±0.2$_{b}$	263.5±10.3^{b}	49.1 ±0.7	2696.2±117.0^{c}	589.1±23.1^{b}	12.9±0.5^{ab}
2006	115	5.3±0.2^{b}	4.4 ±0.2^{b}	284.3±08.8^{c}	53.6 ±0.6	2942.1±99.7^{d}	721.5±19.6^{c}	15.9±0.5^{c}
2007	77	5.0±0.2^{ab}	4.0 ±0.2^{ab}	256.2±10.7^{a}	51.6 ±0.7	2168.4±121.0^{a}	563.7±23.8^{a}	12.2±0.6^{a}
2008	58	5.1±0.2^{ab}	3.8±0.2^{a}	253.5±11.8^{a}	49.9 ±0.8	2126.7±133.0^{a}	595.4±26.2^{b}	13.0±0.6^{b}
2009	24	4.8±0.4^{a}	3.6±0.3^{a}	240.4±18.3^{a}	49.7 ±1.3	2229.8 ±207.0^{b}	603.1±40.9^{b}	13.2±0.9^{b}
P-value		<0.05	<0.01	<0.05		<0.01	<0.01	<0.01
Season								
Winter	103	5.4±0.2	4.6 ±0.2^{d}	265.8±9.3^{b}	49.2 ±0.7^{b}	2340.6±105.0^{a}	514.9±20.8^{a}	11.1±0.5^{a}
Summer	83	5.1±0.2	3.6±0.2^{a}	234.1±10.6^{a}	45.8 ±0.7^{a}	2219.7±120.0^{a}	631.8±23.6^{b}	14.0±0.5^{b}
South-west monsoon	60	4.6±0.3	3.9±0.2^{b}	261.9±12.3^{b}	56.8 ±0.9^{c}	2524.5±140.0^{b}	677.5±27.6^{c}	14.8±0.6^{b}
North-east monsoon	108	5.3±0.2	4.3±0.2^{c}	276.4±9.4^{c}	51.9 ±0.7^{b}	2645.8±107.0^{b}	634.0±21.1^{b}	13.9±0.5^{b}
P-value			<0.01	<0.01	<0.05	<0.05	<0.01	<0.01
Parity						*P*<0.01	*P*<0.01	*P*<0.01
1st	64	5.4±0.2	4.1±0.2	262.9±11.2	48.9 ±0.8	2148.0±126.0^{a}	566.6±24.9^{a}	12.3±0.6^{a}
2nd	49	5.3±0.3	4.3±0.2	273.5±12.7	51.8 ±0.9	2318.2±143.0^{b}	554.8±28.2^{a}	12.2±0.7^{a}
3rd	37	4.9±0.3	4.3±0.2	263.7±14.1	54.2 ±1.0	2362.7±159.0^{b}	574.9±31.3^{a}	12.4±0.7^{a}
4th	27	4.9±0.3	3.9±0.3	249.7±16.4	50.9 ±1.1	2363.8±185.0^{b}	619.4±36.5^{b}	13.5±0.8^{b}
5th	25	5.3±0.3	4.2±0.3	252.8±17.1	47.5 ±1.2	2697.7±193.0^{c}	654.3±38.1^{c}	14.4±0.9^{c}
≥6th	152	4.9±0.2	3.8±0.1	254.8±7.43	52.1 ±0.5	2705.4±84.1^{d}	717.4±16.6^{d}	15.8±0.4^{d}
P-value						<0.01	<0.01	<0.01

Winter: December to February. Summer: March to May. South-west monsoon: June to August. North-east monsoon: September to November. Means bearing same superscript at each column and trait do not differ significantly at *P*<0.05.

Litter weight at birth and weaning

There was no significant difference in litter weight at birth and weaning between Soviet Chinchilla and White Giant breeds. The litter weight at birth in Soviet Chinchilla and White Giant breeds was slightly higher than the values reported in Soviet Chinchilla (217.9 g) and White Giant (223.7 g) breeds maintained in tropical climatic conditions of Tamil Nadu (Bharathy, 2008). Kumar *et al.* (2006) observed similar litter weight at birth (241.2 g) and weaning (2.3 kg) in Soviet Chinchilla, but litter weight at weaning was slightly higher (2.8 kg) in White Giant rabbits in high altitude conditions of Tamil Nadu. Das and Nayak (1991) and Gulyani (2001) reported 40% more weight in the litter weight at birth and weaning in Soviet Chinchilla and White Giant breed either in hot and humid climatic conditions or tropical climatic conditions of India. The highest weight at birth and weaning was directly related to the highest litter size.

Year of birth had a significant effect on litter weight at birth (*P*<0.05) and weaning (*P*<0.01) in both breeds, which was comparable with the finding of Sood *et al.* (2006) in Angora rabbits. Season of birth had a significant effect on litter weight at birth and weaning in Soviet Chinchilla (*P*<0.05) and White Giant (*P*<0.01) breeds. In general, the litters born during the north-east monsoon season seems to show highest weight. However, the litters born during the summer season attained lower body weights. The seasonal effect upon the early growth performance of rabbit was also reported by Kumar *et al.* (2001, 2006) and Sood *et al.* (2006). The difference associated with the kindling season can be attributed to the prevalent environmental conditions and stress factors affecting feed intake. The lower litter weight at birth during summer season could be due to the limited availability of good quality green forage to the females.

Parity had a significant effect (*P*<0.01) on litter weight at weaning in both the breeds. Litter weight at weaning increased with parity order. This is in agreement with increase in milk production as parity order advanced (see review by Maertens *et al*., 2006). Higher litter weight at birth and weaning were reported for White Giant rabbits at different parities (Umesh Singh *et al*., 2007) reared under sub-temperate conditions of India.

Individual weight at birth and weaning and pre-weaning growth rate

No difference was found for average weight of kits at birth between Soviet Chinchilla and White Giant breeds. However, kits of Soviet Chinchilla breed showed higher weight at weaning (694.1 g) than those of White Giant breed (614.6 g; $P<0.01$) as a consequence of their higher pre-weaning growth rate (15.3 g/d in Soviet Chinchilla breed *vs.* 13.4 g/d in White Giant breed; $P<0.01$). The average weight of kits at birth and weaning was within the range of values reported in the literature (Ghosh *et al.*, 2006; 2008; Bharathy, 2008; Gnana Prakash and Ramesh Gupta, 2008).

Year and season of birth and parity had a significant ($P<0.01$) effect on average weight of kits at weaning and pre-weaning growth rate in both breeds. These results were in accordance with the finding of Sood *et al.* (2006). Kits born during the south-west monsoon season seem to show higher average weight at weaning and pre-weaning growth rate. However, kits born during the winter season attained lower average weight at weaning and pre-weaning growth rate. The difference associated with the kindling season can be attributed to the prevalent environmental conditions and stress factors affecting feed intake (Eberhart, 1980). The higher growth rate observed in the south-west monsoon could be due to the availability of abundant supplies of green forage, as the tract receives a substantial amount of rainfall during this season

CONCLUSIONS

The present study revealed that both Soviet Chinchilla and White Giant breeds performed satisfactorily under the existing tropical climatic conditions of Tamil Nadu and could be used for profitable meat production to meet the growing demands. Factors such as year and season of birth had an appreciable effect on different production traits. Hence, better breeding management interventions should be carried out to increase the productivity of both breeds under the prevailing agro-climatic conditions.

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