World Rabbit Science

World Rabbit Sci. 2010, 18: 111 - 116
doi:10.4995/wrs.2010.18.14

DESCRIPTIVE CHARACTERIZATION OF A NIGERIAN HETEROGENEOUS RABBIT POPULATION - FACTORS AFFECTING LITTER TRAITS

Oseni S.O. and Ajayi B.A.

Department of Animal Science, Faculty of Agriculture. Obafemi Awolowo University. Ile-Ife, Nigeria.

Abstract: This study evaluated the effect of female body weight at conception (FWC), season of mating (SM), type of mating (TM) and litter size at birth (LSB) on the litter performance in a heterogeneous Nigerian population of rabbits. Data on 116 litters from 10 bucks and 48 does across three parities were analysed. Reproductive traits evaluated included LSB, number born alive (NBA), litter sizes and weights at 7, 14 and 21 d post-kindling, pre-weaning survival rate (SR) and daily weight gain of kits from kindling to weaning (DWG). A fixed linear model that included FWC (light and heavy does), TM (homospermic and heterospermic matings), LSB classes (low, medium and large) and SM (rainy or dry) was used. Results showed that heavier does at concenption showed higher performance for LSB and NBA (P<0.05) than lighter does. Average weight of kits at kindling and at 28 d, as well as kit SR and DWG, were significantly higher in low-sized litters, when compared with intermediate- and large-sized litters (P<0.05). LSB, NBA and litter size at weaning were higher in litters produced by heterospermically mated does compared with homospermically mated does. Season of mating affected LSB and NBA (P<0.05), being significantly larger the litters in the rainy season.

Key Words: Nigerian rabbits, heterogeneous population, female weight, litter size, kit survival.

INTRODUCTION

Stocks of rabbits used in many parts of the developing world including Nigeria are highly heterogeneous and heterozygous, on account of their multiple breeds of origin (Lebas *et al*., 1997; Lukefahr, 1998). These stocks are adapted to low-input, backyard or traditional systems, which are predominant in sub-Saharan Africa (Colin and Lebas, 1996). Lukefahr (2000) noted that a high degree of heterozygosity (inherent in such populations) might be important for fitness-related characteristics (e.g. fertility and survival) as a means for eventual local adaptation. Further exploitation of these heterogeneous stocks could be hinged on detailed scientific information about factors affecting fertility, prolificacy and litter traits at kindling and at weaning, including average daily gain and kit survival rate.

Among other rabbit breeds and genotypes, Poigner *et al*. (2000) reported that average daily gain from birth to 21 d was affected by litter size at birth, while Krogmeier and Dzapo (1991) noted that kit survival rate was affected by the size of the litter and birth weight of the kits. Other reports (Somade, 1985) noted that type of mating (homospermic vs. heterospermic) affected prolificacy in New Zealand White rabbits, while El Amin (1979) and Rommers *et al*., (2002) noted that doe weight at conception could have a marked effect on prolificacy. Moreover, some studies (e.g. Fleischhauer *et al*., 1986; Cheeke, 1991) have

Correspondence: S.O. Soseni, soseni@oauife.edu.ng
Received *January 2009* - Accepted *April 2010*

established relationships between the number of teats the doe has and kit survival (with higher survival rates recorded for does with a higher number of teats). However, for heterogeneous rabbit populations the extent to which these factors affect overall doe productivity is not well established. Such information could contribute to designing suitable breeding programmes for this population in Nigeria and other countries in sub-Saharan Africa. The aim of this study was to assess the effect of some fixed factors (e.g. doe weight at conception, type and season of mating and litter size at birth class) on prolificacy, pre-weaning kit survival and daily kit gain for a heterogeneous population of rabbits in south-western Nigeria.

MATERIALS AND METHODS

Rabbit population and management

This study was conducted at the Rabbit Unit of the Teaching & Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria, between April 2006 and March 2007. Ten bucks and 48 does of 8 to 10 mo of age and weighing between 1.5 and 2.5 kg were used. Animals were identified by ear tattoo and cage tagging. All the rabbits were housed individually in cages of dimension 76 × 62 × 42 cm, placed 90 cm from the floor. The cages were made of wood with galvanized wire mesh at the sides and bottom. In each cage, there were two earthen pots for feed and water. These cages were located inside a building designed with wood and wire mesh at the sides to ensure adequate ventilation and comfort.

Matings were routinely done in the morning before the weather gets hot. Each doe was taken to the cage of the buck and after mating, the doe was returned to her cage. Pregnancy was detected on 14 d post-mating. Does that were found not gravid were re-mated immediately. For all pregnant does, kindling boxes were placed in their cages on 25 d post-mating. At kindling, the nest boxes were checked, and total and live litter sizes and weight at kindling were recorded. The litters were monitored daily for mortality. The size and weight of each litter was recorded weekly until weaning at 28 d post-kindling.

Feeding

Rabbits were fed a palm kernel-based diet with the following per cent proximate composition: dry matter=90.95, ash=8.14, crude fibre=5.9, ether extract=7.8, crude protein=24.3 and nitrogen free extract=53.9. Ingredients used to formulate the diet, as described by the manufacturer (Joam Farm Ventures®, Ile-Ife, Nigeria), included maize (34%), wheat offal (32%), palm kernel cake (23.8%), soya (5%), oyster (2%), bone meal (2%), fish meal (0.5%), methionine (0.1%), lysine (0.1%), pre-mix (0.25%) and salt (0.25%).

Data collected

Data collected for each doe included doe teat number (three classes: 8, 9 and 10 teats), female body weight at conception (FWC; two classes: FWC≤1750 g and FWC>1750 g) and type of mating (TM; homospermic or the mating of the doe twice to the same buck and heterospermic mating or the mating of the doe to two different bucks). Litter size at birth (LSB) and number born alive (NBA) were recorded within 24 h of kindling. Litter sizes and kit weights were recorded at 7, 14, 21 and 28 d post-kindling. Season of mating (SM) was also registered as rainy (May to October) or dry (November to April). Daily weight gain (DWG) and survival rate (SR) of kits from kindling to 28 d were also determined.

LSB classes were defined as low for LSB≤3 kits, medium for LSB of 4 to 5 kits and high for LSB≥6 kits, while SR was defined as litter sizes at 7, 14, 21 and 28 d post-kindling, relative to the initial LSB.

Statistical analyses

Data were analysed using the GLM procedure of the Statistical Analysis System (SAS, 2004).

To assess factors affecting prolificacy (e.g. LSB, NBA) and weekly litter sizes to 28 d, the following fixed model was fitted:

$$Y_{ijkl}=\mu + FWC_i + SM_j + TM_k + \epsilon_{ijkl}$$

where μ is the overall mean, FWC the female body weight at conception, SM the season of mating, TM the type of mating class, and Єijkl the random error.

For kit weight at birth, survival rate and daily kit gain from birth to weaning, the following fixed model was fitted:

$$Y_{ijklm}=\mu + FWC_i + SM_j + TM_k +LSB_l+ \epsilon_{ijklm,}$$

where all the effects were defined as previously, while LSB was the litter size at birth class. Means comparison was done using the Duncan test. Preliminary analysis indicated that all interaction effects were non significant and so were not included in the final models used.

RESULTS AND DISCUSSION

Table 1 shows the effect of FWC, TM and SM on LSB, NBA and litter size at 28 d. LSB and NBA values were within the range of 1 to 8 kits frequently observed for hot and sub-tropic climates (Onifade *et al*., 1999; Ghosh *et al*., 2008; Yassein *et al*., 2008), being both significantly larger ($P<0.05$) for heavier does. The effect of FWC on the litter size traits controlled is also illustrated in the Figure 1, which reveals that heavy females at conception also had higher litter sizes at 7, 14 and 21 d post-kindling, thus highlighting the importance of mating doe weight on later prolificacy. These results are in agreement with several reports in the literature. According to El Amin (1979), a large mature doe weight provides an improved maternal environment necessary for foetal survival during embryogenesis, while Rommers *et al*. (2002) reported that litter size at first parity could be improved as doe body weight at first insemination increased. Rommers (2004) recommended that young does must reach an optimum body weight in order to maximise reproductive performance of the female. However, the advantage in prolificacy recorded at kindling was

Table 1: Least squares means and standard error (SE) for the effects of doe weight at conception, type of mating and season of mating on litter sizes at kindling and weaning.

	Litter size at kindling		Number born alive		Litter size at 28 d	
	No.	Mean±SE	No.	Mean±SE	No.	Mean±SE
Doe weight at conception (g)						
≤1750 g	51	4.29±0.20[a]	50	4.18±0.20[a]	45	3.40±0.22
>1750 g	60	5.00±0.19[b]	57	4.81±0.19[b]	52	3.77±0.21
Type of mating:						
Homospermic	55	4.18±0.19[a]	54	4.11±0.19[a]	49	3.17±0.20[a]
Heterospermic	56	4.99±0.20[b]	53	4.89±0.18[b]	48	3.89±0.22[b]
Season of mating						
Rainy	68	5.00±0.18[a]	66	4.86±0.17[a]	54	3.44±0.23
Dry	43	4.16±0.22[b]	41	3.95±0.22[b]	35	3.79±0.21

[ab] Means along columns for each trait with different superscripts are significantly different ($P<0.05$)

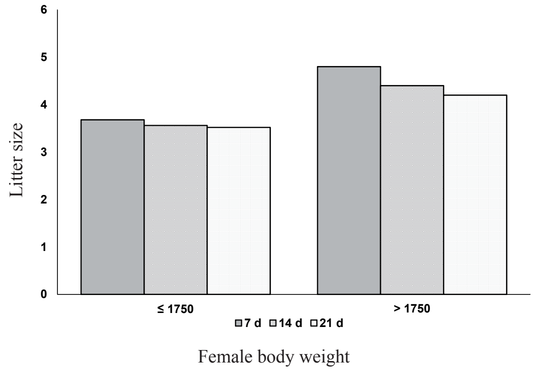

Figure 1: Effect of female body weight at conception on litter size traits at 7, 14 and 21 d.

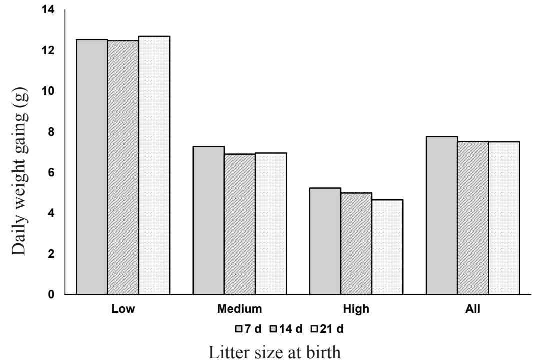

Figure 2: Effect of the litter size at birth (low: ≤3; medium: 4 to 5; high: ≥6) on pre-weaning daily weight gain kits at 7, 14 and 21 d.

not translated to superior litter size at weaning. A possible reason could be the highest kit mortality rate associated to larger litters. This observation highlight the importance of adequate management (improved feeding, health-care and heat stress mitigation strategies) especially in the humid tropics, in order to reduce pre-weaning kit losses.

Table 1 also shows the effect of TM on LSB, NBA and litter size at weaning, wehere all the traits significantly greater for the heterospermically ($P<0.05$) than for homospermic-mated females. Previous reports (Somade, 1985) have also shown how mating a doe to two or more bucks could improve LSB and NBA. Season of mating also affected LSB and NBA ($P<0.05$), being significantly larger the litters in the rainy season.

Table 2 shows the effect of LSB on average kit weight at kindling and 28 d, and on DWG. The effect of LSB on the evolution of DWG is further shown in Figure 2. LSB significantly affected kit weight at kindling and weaning as DWG during lactation ($P<0.05$). Kits born in low LSB were heaviest at birth and had the highest DWG, maintaining their weight advantage during whole lactation (Figure 3). Kits born in low litter sizes had a superior DWG (12.54 g) than kits born in the intermediate and large LSB (6.79 and 4.78, respectively), as intra-litter competition could be less for rabbits born in low LSB when compared to rabbits born in large litters. Poigner *et al.* (2000) observed that rabbit kits born in the heaviest litters gained 5.8 g more during the first three weeks of life. The mean DWG recorded for the low LSB rabbits (12.5 g per day) was slightly lower (14.4 g) to that reported by Ayyat and Marai (1998) under subtropical

Table 2: Least squares means and standard error (SE) for the effect of litter size at birth on kits weight at kindling, weight at 28 d and daily gain in kit weight from kindling to 28 d.

LSB category	Average kit weight at kindling (g)		Average kit weight at 28 d (g)		Daily kit gain to 28 d (g)	
	No.	Mean ± SE	No.	Mean ± SE	No.	Mean ± SE
Low (≤ 3 kits)	54	54.33±1.88^{b}	43	407.21±16.04^{c}	43	12.54±0.55^{c}
Medium (4-5 kits)	270	44.17±1.16^{a}	194	234.11±9.80^{b}	194	6.79±0.34^{b}
High (≥ 6 kits)	211	41.36±1.64^{a}	121	174.69±14.89^{a}	121	4.78±0.51^{a}

^{abc} Means along columns for each trait with different superscripts are significantly different ($P<0.05$).

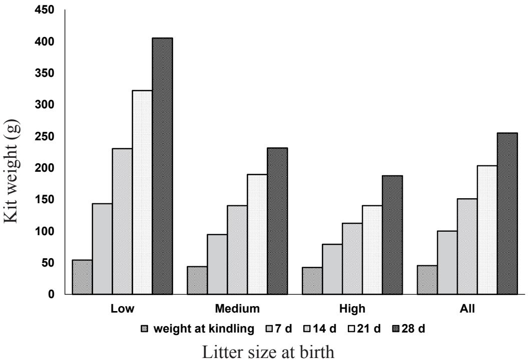

Figure 3: Effect of litter size at birth (low: ≤3; medium: 4 to 5; high: ≥6) on weight at kindling, 7, 14, 21 and 28 d.

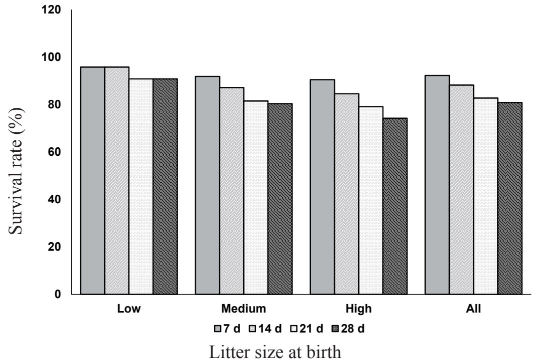

Figure 4: Effect of litter size at birth (low: ≤3; medium: 4 to 5; high: ≥6) on kit survival rate at 7, 14, 21 and 28 d.

conditions. Recently, Kpodekon *et al*. (2008) reported a mean DWG of 28.5 g for kits derived from a local population in Benin Republic.

Finally, the evolution of kit SR is shown in the Figure 4. The SR of kits from low, medium and high litter sizes at 28 d post-kindling were 90, 80 and 74% respectively, indicating a trend for high SR for kits born in low LSB compared to the other LSB classes. Other previous works (Tawfeek, 1995; Rashwan and Marai, 2000) noted that LSB affects the mortality of suckling rabbits, with higher kit mortality in large litter sizes. Pre-weaning mortality values reported in the literature include 30 to 40 % for a mixed rabbit population in Nigeria (Onifade *et al*., 1999), 6 to 22% for a local rabbit population in Benin Republic (Kpodekon *et al*., 2004; Akpo *et al*., 2008), and 16% for a White rabbit population in Algeria (Zerrouki *et al*., 2007).

CONCLUSION

From the study of this Nigerian heterogeneous rabbit population, the following conclusions are drawn: (a) heavier females at mating had a superior reproductive performance, (b) kits born in low-sized litters always showed greater live weight, daily weight gain and survival rate up to weaning age, and (c) litters from heterospermically-mated females had larger values for litter size from birth to weaning.

Acknowledgement: The authors gratefully acknowledge the International Foundation for Science (IFS) of Sweden for its financial support (through grant B3871-1). The efforts and assistance of Jimi Talabi and Nike Olabode in data collection are appreciated.

REFERENCES

Akpo Y., Kpodékon T.M., Tanimomo E., Djago A.Y., Youssao A.K.I., Coudert, P. 2008. Evaluation of the reproductive performance of a local population of rabbits in south Benin. *In Proc.: 9th World Rabbit Congress, 10-13 June, 2008. Verona, Italy. 29-33.*

Ayyat M.S., Marai F.M. 1998. Evaluation of application of the intensive rabbit. Pproduction systems under the sub-tropical conditions of Egypt. *World Rabbit Sci., 6: 213-217.*

Cheeke P.R. 1991. The bottom line. *J. Appl. Rabbit Res., 14: 131-133.*

Colin M., Lebas F. 1996. Rabbit production in the world. A proposal for every country. *In Proc.: 6th World Rabbit Congress, 9-12 July, 1996. Toulouse. France. Vol.3: 323-330.*

El Amin F.M. 1979. Reproductive performance of rabbits selected for post-weaning growth rate. Workshop on rabbit husbandry in Africa, Morogoro, Tanzania. *Tropical Animal Production, 4: 292-299.*

Fleischhauer H., Shlolaut W., Lange K. 1986. Influence of number of teats on rearing performance of rabbits. *J. Appl. Rabbit Res., 8: 174 -176.*

Ghosh S.K., Das A., Bujarbaruah K.M., Das Asit, Dhiman K.R., Singh N.P. 2008. Effect of breed and season on rabbit production under subtropical climate. *World Rabbit Sci., 16: 29-33.*

Kpodekon M. R., Djago Y., Farougou S., Coudert P., Lebas F. 2004. Results of the technical management of four rabbit farms in Benin. *In Proc.: 8th World Rabbit Congress, 7-10 September, 2004. Puebla, Mexico. 555-561.*

Kpodekon T.M., Youssao A.K., Tossou C.M., Djago A.Y., Coudert P. 2008. Effects of molasses incorporation in rabbit fattening diet on growth performances. *In Proc.: 9th World Rabbit Congress, 10-13 June, 2008. Verona, Italy. 711-716.*

Krogmeier D., Dzapo V. 1991. Performance of New Zealand White and Gigant Silver rabbits and their reciprocal crosses. 2. Heterotic effects on growth, reproduction and variability. *Arch. für Geflügelkunde, 55: 158-162.*

Lebas F., Coudert P., Rochambeau, H. De, Thebault, R.G. 1997. The Rabbit: Husbandry, Health and Production. *2nd Ed. FAO Rome.*

Lukefahr S.D. 1998. Review of global rabbit genetic resources: special emphasis on breeding programmes and practices in the Less Developed Countries. *Anim. Gen. Res. Inf., 23: 49-67.*

Lukefahr S.D. 2000. National rabbit project of Ghana: a genetic case study. *In: S. Galal, J. Boyazoglu and K. Hammond (Eds.). Workshop on developing breeding strategies for lower input animal production environments Bella, Italy. ICAR Technical Series No. 3, pp.: 307-318.*

Onifade A.A., Abu O.A, Obiyan R.I., Abanikannda O.T.F. 1999. Rabbit production in Nigeria: some aspects of current status and promotional strategies. *World Rabbit Sci., 7: 51-58.*

Poigner J., Szendro Zs, Levai A., Radnai T., Biro-Nemeth E. 2000. Effect of birth weight and litter size on growth and mortality in rabbits. *World Rabbit Sci., 8: 17-22.*

Rashwan A.A., Marai I.F.M. 2000. Mortality in young rabbits. A review. *World Rabbit Sci., 8: 111-124.*

Rommers J.M., Meijerhof R., Noordhuizen J.P.T.M., Kemp B. 2002. Relationships between body weight at first insemination and subsequent body development, feed intake and reproductive performance of rabbit does. *J. Anim. Sci., 80: 2036-2042.*

Rommers J.M. 2004. Breeding of young female does. *In Proc.: 8th World Rabbit Congress, 7-10 September, 2004. Puebla, Mexico. 1518-1531.*

SAS. 2004. SAS/STAT User's Guide (Release 8.03). *SAS Inst. Inc., Cary NC, USA.*

Somade B. 1985. Influence of two environments on the reproductive performance of New Zealand White rabbits. *J. Anim. Prod. Res., 2: 113-122.*

Tawfeek M.I. 1995. Performance of doe rabbits and their young as affected by remating interval, litter size at birth and month of kindling in New Zealand White and Bauscat pure breeds under Egyptian conditions. *Egyptian J. Rabbit Sci., 5: 101-115.*

Yassein S.A., Mahmoud K.Gh. M., Maghraby N., Ezzo O.H. 2008. Hot climate effects and their amelioration on some productive and reproductive traits in rabbit does. *World Rabbit Sci., 16: 173-181.*

Zerrouki N., Kadi S.A., Lebas F., Bolet G. 2007. Characterisation of a kabylian population of rabbits in Algeria: birth to weaning growth performance. *World Rabbit Sci., 15: 111-114.*