Effect of generational differences, housing systems and seasonal variations on the reproductive performance of rabbits raised in humid tropics

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Abstract

Reproductive data from 24 does (Chinchilla X New Zealand White) of twenty weeks, were analyzed to determine the effect of generation, housing systems and season on the reproductive performance of rabbits raised in the humid tropics. The experiment was carried out during four seasons namely: early dry season (EDS-September to November), late dry season (LDS-December to February), early rainy season (ERS-March to May) and late rainy season (LRS-June to August). The study was repeated in the second generation and the data obtained were subjected to analysis of variance in a 2x2x4 factorial arrangement. Factors considered were generations, housing systems, and seasons respectively. Highest breeding efficiency of 83.33% was obtained in the first generation and maximum litter size at birth (35) and weaning (28) were observed in caged-does that kindled in EDS of first and second generations respectively, while does housed on deep litter system produced the smallest litter size at birth (24) and weaning (18) in the ERS of the second generation. Highest (12) and least (4) pre-weaning losses were recorded in caged-does that kindled in ERS of the first and second generation respectively, whereas highest average birth weight (120.58g) was observed in litters of deep litter-does that kindled in EDS of the second generation. These results indicated that the production of rabbits for breeding purposes is better achieved during early dry season (September-November) and also revealed that deep litter system allows satisfactory performance and has comparative advantage over wooden cage system considering the reduction in housing cost and can be used to improve the nutritional status of the family and also to obtain some supplementary income.

Key words: Season, Breeding efficiency, Litter size, Cage, Deep litter.

Introduction

There has been increased awareness of the advantages of rabbit meat production in the developing countries as a means of alleviating world food shortages (Ajala and Balogun 2004). This could be attributed to the rabbit's high rate of reproduction, early

maturity, rapid growth rate, high genetic selection potential, efficient feed and land space utilization, limited competition with humans for foods, and high quality nutritious meat (Cheeke, 1980). Rabbit meat is high in protein, low in cholesterol and sodium which makes it the ideal meat

for people with coronary heart disease and high blood pressure related problems (Biobaku and Oguntola, 1997). The meat of rabbit is comparable to broiler chicken in terms of nutritive quality, organoleptic quality and mineral contents (Biobaku, 1998).

Despite the advantages listed above, seasonal variations have been reported to affect the reproductive potential of rabbit significantly especially in tropical environments with varying climatic conditions. It has been previously reported that domestic rabbits kept under normal conditions in commercial herds also manifest seasonal patterns of reproductive activity (Lebas *et al.* 1986) although, contradictory findings have been reported by Luzi *et al.* (1999). Housing systems have also been reported to influence the reproductive performance of rabbits. Much information exists on rabbits reared in different types of cages, but the information on reproductive performance of rabbits reared on deep litter system is scanty when compared with those reared traditionally in cages. Therefore, the aim of this study was to investigate the effect of generational differences, housing systems and seasonal variations on the reproductive performance of rabbits raised in humid tropics.

Materials and Methods

Experimental Site

The research was carried out at the Rabbitary Unit of the University of Agriculture Teaching and Research Farm, Alabata road, Abeokuta, Nigeria (7°10'N and 3°2'E). The area lies in the South West of Nigeria and has a prevailing tropical climate with a mean annual rainfall of about 1037mm. The mean ambient temperature of 28°C to 36°C and relative humidity of 60% to 94% existed during the study with a

yearly average of about 82% (Google Earth, 2006). The experiment was carried out during four seasons (2008 and 2009) namely:

Early dry season (EDS)-September to November

Late dry season (LDS)-December to February

Early rainy season (ERS)-March to May

Late rainy season (LRS)-June to August

Experimental Rabbits and Management

A total of twenty-four rabbit does (Chinchilla X New Zealand White) were randomly allotted into 2x2x4 factorial arrangement of two housing systems each (cage and deep litter systems) and each bred at four different seasons of the year (EDS, LRS, ERS and LRS) for two generations. There were twelve rabbits allotted and housed individually in the wooden cage 105 x 85 x 60cm. The wooden cages were housed in a concrete block dwarf wall building while the upper half was covered with wire mesh. The deep litter system was carried out in a similar building like the stable housing the wooden cages. This house was also washed and disinfected with Morigad® prior to the spreading of wood shavings on the floor and stocking of rabbits. The litter was changed fortnightly and replaced with fresh wood shavings to prevent the build-up of pathogens, consequently resulting in disease outbreak. A good hygienic environment was maintained throughout the experiment and all necessary medications were given as routine management practices.

Feeding: Each animal was served 100g concentrate (Table 1) in the morning followed by 100g of forage which was either *Tridax procumbens* or *Euphorbia heterophylla* in the afternoon. Water was supplied *ad libitum* throughout the experimental period. Each housing system consisted of three replicates of four males

each and three replicates of four females each. All the routine and occasional management practices were carried out as and when due throughout the seasons.

Mating: The does were mated at maturity (twenty-four weeks) with a mating ratio of 1:4; proven buck used for mating were obtained from same experimental treatment and of the same age range with the does. The does were taken to buck hutch in the morning and in the evening for mating; the bucks were allowed to ride 3-4 times before they were withdrawn. Pregnancy test was carried out on the does by palpating on the 14th and 20th day after service. A clean and well-disinfected kindling box was provided on the 28th day for the does to make nest of fur in preparation for birth. The rabbits were identified by their coat colour and weighed one week after birth using hand gloves to handle the kits. After weaning at 8 weeks, the young rabbits were fed daily and supplied with water *ad libitum*. Subsequent weights were taken weekly. Forty-eight weaner rabbits from the litters obtained in the first generation were used to carry out the experiment in the second generation. The reproductive parameters determined were breeding efficiency, litter size at birth and weaning, pre-weaning loss and average birth weight.

Data collection and statistical analysis

Breeding efficiency was expressed in terms of percentage of does that kindled following mating. Litter size at birth was determined by the number of kits per doe at birth while litter size at weaning was determined by the number of kits per doe at weaning. Pre-weaning loss was obtained by subtracting litter size at weaning from litter size at birth and average birth weight was determined by weighing all kits of a doe at birth and finding their average. Data collected were subjected to analysis of

variance (ANOVA) techniques using least squares (SAS, 1999). The mean values for seasons, generations and housing systems were tested for significant difference by the Duncan Multiple Range Test at 5% level of significance (Duncan, 1955).

Results and discussion

The effect of generation on the reproductive performance of the experimental rabbits is shown in Tables 1a and 1b. The number of does that kindled and breeding efficiency ranged from 6 to 10 and 50.00% to 83.33%, and their mean values were significantly ($p < 0.05$) higher in the first generation than the second generation. All the does used in this study were bred throughout the seasons including the period of high ambient temperature confirming the observation of Somade (1982) that if mating is attempted often enough, does can be successfully mated even during the hot dry season. This result, hence, implies that it may be possible to undertake an all year round breeding in commercial rabbitry under tropical condition. Litter size at birth and weaning ranged from 24 to 35 and 18 to 28 respectively in both generations. Litter size at birth obtained in this study was lower than that reported by Lukefahr and Goldman (1985) in Cameroon. This difference may be attributed to the body size of the does as they bred does that were 2.5kg and above. Afifi *et al.* (1989) reported that the weight of the doe affects the litter size at birth. It was also observed that litter size had influence on the mean birth weight; this is similar to the report of Afifi *et al.* (1980) and Lukefahr *et al.* (1983). This may be due to factors such as the uterine environment, feeding and high ambient temperature (Odubote and Akinokun, 1991). The highest pre-weaning loss of 12 was recorded in the first

Table 1a: Effect of generation on reproductive performance of rabbits

ration	Season	System	No. of does mated	No. of does that kindled	Breeding efficiency (%)	Litter size at birth	Litter size at weaning	Pre-weaning loss	Average birth weight (g)
EDS	Cage	DL	12	10	83.33	32	25	7	107.08
		DL	12	8	66.67	30	23	7	115.83
LDS	Cage	DL	12	9	75.00	32	23	9	109.17
		DL	12	7	58.33	28	20	8	111.00
ERS	Cage	DL	12	9	75.00	35	23	12	112.08
		DL	12	8	66.67	33	23	10	115.50
LRS	Cage	DL	12	7	58.33	30	22	8	109.00
		DL	12	6	50.00	28	20	8	105.67
EDS	Cage	DL	12	9	75.00	35	28	7	109.58
		DL	12	7	58.33	33	22	11	120.58
LDS	Cage	DL	12	8	66.67	31	25	6	110.91
		DL	12	7	58.33	30	20	10	113.08
ERS	Cage	DL	12	7	58.33	30	26	4	109.42
		DL	12	6	50.00	24	18	6	115.83
LRS	Cage	DL	12	7	58.33	28	23	5	112.33
		DL	12	6	50.00	28	21	7	113.83

Key: EDS = Early dry season (September – November); LDS = Late dry season (December – February); ERS =

Early rainy season (March – May); LRS = Late rainy season (June – August)

DL = Deep litter

generation among litters of does housed in the cage during season 3 (ERS-early rainy season) followed by a pre-weaning loss of 11 in the second generation during season 1 from litters of does raised on the deep litter system. Thus, the pre-weaning loss was higher in the rainy season than the dry season in the first generation but the reverse was observed in the second generation. The average birth weight ranged from 107.08g to 115.50g and 109.42g to 120.58g in the first and second generation respectively.

The mean values of the litter size at birth and pre-weaning loss were higher in the first generation than the second generation while those of litter size at weaning and average birth weight were higher in the second generation than the first generation though not significantly ($p>0.05$) different. The pre-weaning loss reported in this study is not as high as those reported in literature. The incidence of higher mortality during the early rainy season in the first generation than the second generation may be attributed to high moisture content which

Table 1b: Main Effect of generation on reproductive performance of rabbits

Parameters	Generation		SEM
	1	2	
No. of does mated	12	12	0.00
No. of does that kindled	8.00 ^a	7.125 ^b	0.28
Breeding efficiency (%)	66.66 ^a	59.37 ^b	2.42
Litter size at birth	31.00	29.25	1.05
Litter size at weaning	22.38	22.88	0.91
Pre-weaning loss	8.63	7.06	0.67
Average birth weight (g)	110.67	113.20	2.35

^{a, b} Means on the same row with different superscripts are significantly different at ($p<0.05$)

tend to favour bacteria and parasitic infections while highest mortality incidence in late dry season of the second generation could be linked to possible effect of elevated rise in body temperature beyond physiological thermoneutral threshold thereby predisposing and reducing resistance of rabbits to pathological infections. High mortality is common in rabbits under captivity in the tropics. Attah (1986) reported a pre-weaning mortality of 71% and 84% for New Zealand White and New Zealand White x Chinchilla crossbred, respectively. Ibrahim *et al.* (2003) reported a litter pre-weaning mortality rate of 74.97% for the purebred New Zealand White rabbit. Fayeye and Ayorinde (2008) reported that the solution to high mortality is improvement in nutrition, and other management practices like the use of prophylactic medications such as vaccines, longer nursing period, gradual change from milk to mash feeds and the use of therapeutic medications like antibiotics and coccidiostat in addition to the exploitation

of crossbred livability.

Table 2 shows the effect of season on the reproductive performance of the experimental rabbits. Season 1 recorded the highest mean values of 8.5, 70.83% and 32.5 for number of does that kindled, breeding efficiency and litter size at birth respectively, among the four seasons studied while the results obtained in seasons 2 and 3 for breeding efficiency and litter size at birth compared favorably with one another. Highest but not significantly ($p>0.05$) different mean values were recorded in season 1 for litter size at weaning and average birth weight while highest pre-weaning loss was recorded in season 2. Birth weight generally increased numerically from late dry through early rainy season and reached a peak during late rainy season after which it declined. But, in this study, seasonal differences did not influence birth weight. Does that kindled in the early dry season had significantly ($p<0.05$) larger litter size (32.5) than does that kindled in the late rainy season (27.25) but were not significantly ($p>0.05$)

Table 2: Main Effect of season on reproductive performance of rabbits

Parameters	Season				SEM
	EDS	LDS	ERS	LRS	
No. of does mated	12	12	12	12	0.00
No. of does that kindled	8.5 ^a	7.75 ^b	7.5 ^c	6.5 ^d	0.34
Breeding efficiency (%)	70.83 ^a	64.58 ^b	62.5 ^b	54.15 ^c	3.03
Litter size at birth	32.5 ^a	30.25 ^{ab}	30.5 ^{ab}	27.25 ^b	1.38
Litter size at weaning	24.5	22.00	22.5	21.5	1.25
Pre-weaning loss	8.13	8.25	8.00	7.00	0.98
Average birth weight (g)	113.27	111.04	113.21	110.21	3.40

^{a, b, c}: Means on the same row with different superscripts are significantly different at ($p<0.05$)

EDS = Early dry season (September – November); LDS = Late dry season (December – February); ERS = Early rainy season (March – May); LRS = Late rainy season (June – August)

different from those that kindled in the late dry and early rainy seasons. Also late dry season kindling was not significantly ($p>0.05$) different from early rainy season kindling.

The effect of housing system on reproductive performance of rabbits is presented in Table 3. The number of does that kindled, breeding efficiency, litter size at birth and litter size at weaning recorded mean values (8.25, 68.74%, 31.63, and 24.38 respectively) that were significantly ($p<0.05$) higher in the cage system than the deep litter system while the deep litter recorded higher but not significantly ($p>0.05$) different values for pre-weaning loss (8.38) and average birth weight (113.92g).

The mean values for breeding efficiency in cage and deep litter systems were 68.74% and 57.29% respectively. The significant result obtained in this study on the effect of housing systems on the numbers of does that kindled, breeding efficiency, litter size at birth and litter size at weaning implies that the cage system favours reproductive performance in rabbits than the deep litter system under tropical conditions. Breeding efficiency and litter size are among other factors determining prolificacy in livestock, and the ability to increase litter

size will generally increase meat production in rabbits. The rise in pre-weaning loss in deep litter system during early dry season and late dry season could be an indication that as the rearing environment was becoming drier, hotter and stressful in those seasons (due to low rainfall and relative humidity), mortality rates increases. It, therefore, implies that dry season breeding may require housing construction that has inbuilt facilities which can reduce ambient temperature during this period. It is also important that management practices which could also aid the performance of does should also be encouraged during this period as does are apt to reject kits under heat stress.

Conclusion

There is seasonal variation in litter size as the highest breeding efficiency and maximum litter size at birth and weaning were observed in caged does that kindled in season 1 of first and second generations respectively while does housed on the deep litter system produced the smallest litter size at birth and weaning in season 3 of the second generation. A decline in the breeding efficiency and litter size at weaning of rabbits in the second generation, most especially during seasons 3 and 4,

Table 3: Main effect of housing system on reproductive performance of rabbits

Parameters	System		SEM
	Cage	Deep Litter	
No. of does mated	12	12	0.00
No. of does that kindled	8.25 ^a	6.88 ^b	0.24
Breeding efficiency (%)	68.74 ^a	57.29 ^b	2.13
Litter size at birth	31.63 ^a	28.63 ^b	1.00
Litter size at weaning	24.38 ^a	20.88 ^b	0.79
Pre-weaning loss	7.31	8.38	0.68
Average birth weight (g)	109.95	113.92	0.10

^{a, b}: Means on the same row with different superscripts are significantly different at ($p<0.05$)

suggested that the prevailing environmental conditions in these seasons might have induced stress and exerted adverse effects on optimum performance of the does. This study also revealed that deep litter system allows satisfactory performance and has comparative advantage over the wooden cage system considering the reduction in housing cost and can be used to improve the nutritional status of the family and also to obtain some supplementary income.

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