INFLUENCES OF SEASONS AND REBREEDING INTERVALS ON GROWTH INDICES OF KITS OF HYLA RABBITS IN SOUTH-WEST, NIGERIA

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ABSTRACT
The objectives of this study were to evaluate the effects of seasons and rebreeding intervals on the growth of kits of Hyla rabbits. Forty mature rabbits, comprising thirty-two does and eight bucks of an average body weight of 2,600 ± 100 g, were used for the study. Records of growth indices of kits from thirty-two does in four sub-seasons of a year: late rain (S_1), early dry (S_2), late dry (S_3), and early rain (S_4) were used to determine the seasonal effects. The thirty-two does were randomly allotted into four experimental treatments: two-week (T_1), four-week (T_2), six-week (T_3), and eight-week (T_4) rebreeding intervals to examine the influences of rebreeding intervals on the kits. Data obtained were subjected to one-way analysis of variance. The results showed that litter weaning weight (LWW), average weaning weight (AWW), litter size at the 12th week, and litter weight at the 12th week were significantly ($p<0.05$) higher in both late rain (S_1) (2544.52 g, 516.52 g, 4.17, and 5436.39 g, respectively) and early dry (S_2) (2340.74 g, 480.39 g, 4.04, and 4986.13 g, respectively). LWW, AWW, and average weight at the 12th week were significantly ($p<0.05$) higher in the six-week rebreeding interval (T_3) (2576.40 g, 546.75 g, and 1318.30 g, respectively). However, mortality between weaning and the 12th week was significantly ($p<0.05$) higher in S_3 (13.94), S_4 (14.39), and T_1 (10.40). It was concluded that late rain, early dry seasons, and a six-week rebreeding interval had favourable influences on the growth of kits of Hyla rabbits.

Key words: Does, weaning, mortality, early and late rain seasons, early and late dry seasons.

DESCRIPTION OF PROBLEM
Rabbits (*Oryctolagus cuniculus*) are preferred for their functional role of providing people with high-protein, low-cholesterol meat at a lower cost and risk than other types of livestock due to their small body size, short gestation period, high reproductive potential, rapid growth rate, genetic diversity, and capacity to use forage and by-products as major diet components (1). Over three hundred rabbit breeds abound around the world, with differences in size, coat colour, ear length, and fur type that exist in both temperate and tropical regions (2). Hyla rabbits are a product of cross breeding of three pure breeds of rabbits. This breed is a product of crossbreeding between the Californian breed, which provides excellent meat quality and efficient feed conversion; the French-developed line INRA 1077, which is used in hybrid breeding and is intended for high meat production and robustness; and the New Zealand White, which is known for its rapid growth, exceptional carcass quality, and calm temperament (3). This makes the Hyla rabbits an excellent breed for meat production. A season is a time of year that is identified by unique weather patterns (4). The earth's tilted axis as it rotates around the sun is a major cause of the seasons. Temperature, relative humidity, and lighting are only a few of the many variables of the season that significantly affect animal welfare (5). Nigeria's climate is primarily tropical, with two distinct seasons (wet and dry), which could be further subdivided into four sub-seasons with an average temperature that ranges from 21 to 35 degrees Celsius (6).

Rebreeding in rabbits refers to the practice of mating a doe again after it has kindled in order to produce a new litter (2). It is a critical aspect of rabbit production that affects productivity, fertility, and health of both the doe and kits (7). Cutting the rebreeding interval short is a workable strategy to boost the quantity of weaned kits produced (8). It is possible for rabbits to mate 24 hours after kindling since they are induced ovulators (9). Because of intensive breeding methods, however, more does may be removed annually due to being "worn out". Even if early

rebreeding is a substantial possibility, neonatal death remains one of the main problems limiting rabbit productivity (10). Short rebreeding intervals after kindling, however, may not allow the does' body reserves to fully recuperate. This could lead to a decrease in fertility, milk production, and litter weight during weaning, as well as an increase in kit mortality (9). Identifying suitable seasons as well as adopting a good time to rebreed after parturition have therefore become challenges in the management of domestic rabbits, particularly in an intensive production system. There may be a chance to boost rabbit production with the knowledge of the impacts of seasons and the right rebreeding interval. Therefore, this study is aimed at to assess the effects of various sub-seasons and rebreeding intervals on the growth performance of Hyla rabbit kits in southwestern Nigeria in order to determine the optimal seasons and best time to rebreed a doe after parturition.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at Rabbitry Unit of the Teaching and Research Farm of Osun State University, Ejigbo Campus, Ejigbo. The area is located within the Forest Zone of Nigeria on latitude 7^0 54'0^0 N and longitude $4^0$18'54^{0}E. The average elevation is 426 metres (11). It has average annual rainfall of 1,330 mm. The rainy season usually lasts from April to October. The laboratory bench work was carried out at a reputable laboratory in Ibadan, Oyo State, Nigeria.

Composition of Experimental Rabbits and their Management

A total of sixty weaners of 35 days old, comprising fifty females and ten males, were purchased from the Rabbitry Unit of the Teaching and Research Farm of Osun State University, Ejigbo Campus, Ejigbo. When they reached six months old with an average weight of 2,600 g ± 100 g, thirty-two does and eight bucks were selected randomly and were exposed to four sub-seasons of a year: S_1 (late rain, July-September), S_2 (early dry, October-December), S_3 (late dry, January-March), and S_4 (early rain, April-June). In a completely randomized design (CRD), the does were assigned to four experimental treatments: T_1 (two-week), T_2 (four-week), T_3 (six-week), and T_4 (eight-week) rebreeding intervals. Each treatment included eight rabbits. One buck was used to service four (4) does in the ratio 1:4.

Housing

The rabbits were kept in a closed-door house in galvanised battery cages that were 55 x 65 x 35 cm in size and raised 80 cm above the ground. They always had access to water through a 0.5-inch (1.27 cm) water pipe with nipples that passed through the cage. Each cell has an L-shaped feeder attached to it. Daily routine management procedures included providing clean water, cleaning the hutches and their surroundings, removing leftover feed, and serving fresh feed every day.

Data Collection

The parameters that were measured for the determination of growth indices in the kits were the litter weaning weight (LWW), average weaning weight (AWW), litter size at the twelfth week (LS_{12thwk}), litter weight at the 12th week (LW_{12thwk}), average weight at the 12th week (AW_{12thwk}) and mortality at the 12th week (M_{12thwk}).

Statistical Analysis

Data collected were subjected to one-way analysis of variance (ANOVA) using IBM Statistical Package for Social Sciences (SPSS) version 25 (12), and mean differences were compared using Duncan's Multiple Range Test of the same statistical package at a 95% confidence level.

RESULTS AND DISCUSSION

Effects of Seasons on the Growth Indices of Kits of Hyla Rabbits

The effects of sub-seasons on the growth indices of kits of Hyla rabbits are shown in the Table 1. Litter weaning weight (LWW), average weaning weight (AWW), litter size at the 12th week (LS_{12thwk}), and litter weight at the 12th week (LW_{12thwk}) were higher ($p<0.05$) in both late rain

(S_1) (2544.52 g, 516.52 g, 4.17, and 5436.39 g, respectively) and early dry (S_2) (2340.74 g, 480.39 g, 4.04, and 4986.13 g, respectively). Average weight at the 12th week (AW_{12thwk}) was higher ($p<0.05$) only in S_1 (1301.57 g). However, mortality at the 12th week (M_{12thwk}) was lower ($p<0.05$) in both S_1 (6.11) and S_2 (6.09). Average weaning weight, average weight at the 12th week, litter weaning weight, and litter weight at the 12th week were high in the first (S_1) and second (S_2) seasons, probably because of good and favourable environmental conditions that encouraged the kits to eat and suck more milk (13). This influence of season observed was not in agreement with the findings of Fayeye and Ayorinde (14). They reported that due to the lower litter size of kits born in the dry season, their individual weights at weaning were higher than those of kits born in the rainy season. Litter size at the 12th week was higher during the late rain and early dry. This could be because of good environmental conditions, which are reflected in higher litter size. Sorhue *et al*. (15) reported a similar result with rabbits from New Zealand and California. Mortality at the 12th week was higher in the late dry season and early rainy season because of high temperature and low relative humidity in the late dry season (16) and high temperature and high relative humidity in the early rainy season (15), which allowed heat stress to set in. Also, bacterial and fungal diseases were promoted at the end of the early rainy season because of a sudden change of temperature that caused a resurgence of bacterial and fungal diseases.

Table 1: **Effects of seasons on growth indices of kits of Hyla rabbits**

Parameters	S_1	S_2	S_3	S_4	SEM
LWW (g)	2544.52^{a}	2340.74^{a}	1633.26^{b}	1672.19^{b}	114.97
AWW (g)	516.52^{a}	480.39^{a}	381.74^{c}	430.76^{b}	16.28
LS_{12thwk}	4.17^{a}	4.04^{a}	3.87^{ab}	3.52^{b}	0.13
LW_{12thwk} (g)	5436.39^{a}	4986.13^{a}	4128.26^{b}	3972.76^{b}	224.38
AW_{12thwk} (g)	1301.57^{a}	1183.04^{b}	1058.26^{c}	1109.33^{bc}	29.41
M $(\%)_{12thwk}$	6.11^{b}	6.09^{b}	13.94^{a}	14.39^{a}	2.39

^{abc} means in the same row with different superscripts are significantly different ($p<0.05$). S.E.M. = Standard Error of Mean. **LWW**: litter weaning weight. **AWW**: average weaning weight. **LS_{12thwk}**: litter size at 12th week. **LW_{12thwk}**: litter weight at 12th week. **AW_{12thwk}**: average weight at 12th week. **M $(\%)_{12thwk}$**: mortality at 12th week. **S_1**: late rain (July-September), **S_2**: early dry (October-December), **S_3**: late dry (January-March), **S_4**: early rain (April-June).

The Impacts of Rebreeding Intervals on Growth Parameters of Kits of Hyla Rabbits

The impacts of rebreeding intervals on growth parameters of kits of Hyla rabbits are expressed in Table 2. Litter weaning weight (LWW), average weaning weight (AWW), and average weight at the 12th week (AW_{12thwk}) were higher ($p<0.05$) in the six-week rebreeding interval (T_3) (2576.40 g, 546.75 g, and 1318.30 g, respectively). Meanwhile, litter size at the 12th week (LS_{12thwk}) and litter weight at the 12th week (LW_{12thwk}) were higher ($p<0.05$) in both T_3 (4.10 and 5494.55 g, respectively) and T_4 (4.13 and 4923.50 g, respectively). However, mortality at the 12th week (M_{12thwk}) was higher ($p<0.05$) in T_1 (10.40). LWW, AWW, and AW_{12thwk} were very high in does in T_3, as were LS_{12thwk} and LW_{12thwk}, which were very high in both T_3 and T_4. This could be as a result of the concurrent lactation-gestation period being no more and gonadotropin depression being minor, which allowed improving receptivity, ovulation, and implantation rate (17). Awojobi and Adejumo (10), and Ghoneim *et al*. (18) noted that cutting the re-mating interval after parturition seemed to have no effect on the litter weaning weights of the kits. Mortality in the 12th week was high in both the two-week and four-week rebreeding intervals, which was an average of 10%. Post-weaning mortality between weaning and the 12th week is usually between 5 and 15%, which is often linked to enteric diseases and weaning stress (19). According to Gidenne *et al*. (20), digestive disorders post-weaning account for the majority of deaths between 5 and 12 weeks.

Table 2: **Effects of Rebreeding Intervals on Growth Indices of Kits of Hyla Rabbits**

Parameters	T_1	T_2	T_3	T_4	SEM
LWW (g)	1837.80^{b}	1815.29^{b}	2576.40^{a}	2175.81^{b}	130.453
AWW (g)	421.07^{bc}	405.58^{c}	546.75^{a}	465.88^{b}	16.233
LS_{12thwk}	3.67^{b}	3.92^{ab}	4.10^{a}	4.13^{a}	0.14
LW_{12thwk} (g)	3883.97^{c}	4704.58^{b}	5494.55^{a}	4923.50^{a}	228.349
AW_{12thwk} (g)	1043.60^{c}	1160.87^{b}	1318.30^{a}	1202.94^{b}	28.406
M $(\%)_{12thwk}$	10.40^{a}	9.94^{a}	6.21^{b}	6.89^{b}	2.93

^{abc} means in the same row with different superscripts are significantly different ($p<0.05$). S.E.M. = Standard Error of Mean. **LWW**: litter weaning weight. **AWW**: average weaning weight. **LS_{12thwk}**: litter size at 12th week. **LW_{12thwk}**: litter weight at 12th week. **AW_{12thwk}**: average weight at 12th week. **M $(\%)_{12thwk}$**: mortality at 12th week. **T_1**: two-week interval, **T_2**: four-week interval, **T_3**: six-week interval, **T_4**: eight-week interval.

CONCLUSION AND APPLICATION

It was concluded that both late rain and early dry seasons positively influenced the litter weaning weight, litter weight at the 12th week, average weaning weight, average weight at the 12th week and litter size at the 12th week including mortality at 12th week. Six-week rebreeding interval performed best in litter size at the 12th week, litter weight at weaning, and the 12th week, including average weaning weight and the 12th week. Mortality was minimal in both the six- and eight-week intervals. Therefore, late rain and early dry seasons (July to December) are the best periods that give optimum growth performance in the kits of Hyla rabbits and six-week rebreeding interval influenced positively the growth performance in kits of Hyla rabbits.

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