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Research Article

Effect of Weight at First Mating on the Performance of New Zealand White Rabbit Population in the Rainforest Zone of Nigeria

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Abstract

It has been generally accepted that for breeders to embark on intensive production of rabbits there is a need to use appropriate body weight rabbit that has better performance. To provide such information, this study was therefore carried out to determine the effect of weight at first mating on the performance of the New Zealand White rabbit population at the University of Benin Teaching and Research Farm. The rabbits were grouped into four based on their weight before the first service (1.00 to 1.49kg, 1.50 to 1.99kg, 2.00 to 2.49kg, and 2.5kg and above) as weight groups 1, 2, 3, and 4 respectively. The rabbits were raised under acceptable management. The experimental animals were fed a commercial diet of 18% CP and 2700kcal/kg ME. Data collected were weight of doe before service (WBS), number of time served (NTS), litter size at birth (LSB), litter size at weaning (LSW), litter weight at birth (LWB), litter weight at weaning (LWW), pre-weaning mortality percentage (PWM), gestation length (GLT), and stillbirth (SBT). The data were subjected to statistical analysis using the R statistical package version 3.3.3 (2017). Significant means were separated using the Duncan Multiple Range Test. The results obtained showed an increasing trend with body weight at first service. The mean values for LWB were 40.08±1.04, 43.83±2.16, 49.26±2.93 and 45.57±3.74 g for weight groups 1, 2, 3, and 4, respectively. Rabbits in weight 2 and 3 had a higher CV of 30%. Mean LWW ranged from 366.20±26.92 in group 1 to 442.90±29.74 in weight group 4. The average LSB was 4 kits. Litter sizes at weaning (LSW) were 3 kits except for group 4 with 4 kits. The body weight at first mating had no significant effect ($P>0.05$) on the performance traits. Gestation length (GLT) and pre-weaning mortality (PWM) showed significance ($P<0.05$). Gestation length (GLT) was highest in weight group 4 with mean days of 32.14±0.40 and the least in group 3 (30.53±0.09). Percentage SBT was highest in group 3 (10.48%) and none was recorded in group 4, 0.00±0.00. Percentage PWM was highest in groups 1 and 2 with 23.25% and 1.50%, respectively, while there was no PWM recorded in groups 3 and 4. The results of the efficiency of gain of offspring from the weight group were not significantly different ($P>0.05$) except for mortality which showed a significant difference ($P<0.05$). Rabbits from weight groups 1 and 3 showed better performance but for the high mortality in group 1, it will be better to mate rabbits for the first time at weight group 3.

Keywords

Weight, First Mating, Performance, New Zealand White Rabbit, Rain Forest Zone

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1. Introduction

The continuous focus and support of government, research institutes, and livestock breeders only on poultry, ruminants, and swine as major sources of protein has led to the general neglect of exploiting the breeding potentials of rabbits (a mini livestock that can bridge the protein deficiency gap between the amount recommended by FAO (36g/d) and that consumed by an average Nigerian (17.79 g/d) [21]. Rabbit production under low-income or backyard systems is a better, cheaper, and more sustainable source of animal protein than most conventional animal protein sources. This is due to its high adaptability and flexibility to household production. Rabbit as an enterprise can contribute to food security for the peasant household [5].

Previous studies done on the performance characteristics of rabbits monitored body weight and reproductive performance of rabbits does (litter size at birth and weaning) and performance characteristics. [18]. The live body weight and linear body measurements contribute significantly to the animal's lifetime performance [6].

There is therefore the need for breeders to embark on intensive production of rabbits using rabbits with appropriate body weight to enhance better performance. However, other studies have centered their research interest on the effect of body weight at mating on reproductive performance. Therefore, the objective of the research was to determine the effect of weight at first mating of New Zealand White doe on the performance of the offspring; determine the variation in performance of offspring from does with different weights at first mating, efficiency of gain of offspring, feed consumed per kg weight gain.

2. Materials and Methods

2.1. Experimental Site and Animals

The experiment was conducted at the rabbit unit of the University of Benin Teaching and Research Farm, Benin City, Nigeria. The farm is located between latitudes 6 °and 6.30 °N of the equator and longitudes 5.40 ° and 6 ° E in the humid rainforest zone of Nigeria. It has an annual temperature range between 24.5 ℃ and 32.7 ℃ with a mean value of 27.6 ℃. Average annual rainfall of 2162mm and relative humidity and daily sunshine is between 63.3 and 81.71% and 5.85 and 7.5 hours with a mean value of 72.5% and 6.68 hours respectively [13]. A population of 31 does and 6 bucks were used for the experiment using a mating ratio of one buck to five does 1:5 to produce the experimental animals. Only those that were to be mated the first time were used to produce a total of Ninety-three (93) offspring.

Each animal was kept in an individual hutch measuring 60 cm ×60 cm ×60 cm. The weaning period adopted was 28 days. The animals were fed with growers' mash in the morning between the hours of 7:00 and 8:00 GMT and forage in the evening between the hours of 17:00 and 18:00 GMT. The proximate composition of the diet as indicated by the manufacturer (Livestock Feeds-Nigeria) is 18% CP, 0.9% EE, 15.31% CF, 6.8% Ash, 99% DM, 65.1 NFE with ME 2700kcal/kg. The rabbits were given antibiotics once a month, and coccidiostat was given once in two months throughout the study to prevent coccidiosis and any other bacterial disease. The housing condition, management, and handling of the animals were approved by the livestock welfare unit of the Department of Animal Science, University of Benin (any approval number?). The study lasted for 8 months in 2017. The daily routine management practices for rabbit rearing were used (reference). The rabbits were identified with indelible ink weekly.

2.2. Breeding Procedure

Does of known weight were bred by taking them to assigned bucks and after every successful mating the does were returned to their hutch, and they were palpated for pregnancy detection after 14 days. When pregnancy was detected, kindling boxes were placed in the breeding hutches of the pregnant does on the 27th day after mating. Daily monitoring of the animals was done regularly. At parturition, dead kits were removed from the hutch and buried. At weaning, the does were taken away from their litters to a separate hutch. After 3 days of being together, the weaners were identified and separated into two per hutch according to body weight where their growth was monitored.

2.3. Data Collection

Data collected on the performance and reproductive traits of the does and growth performance of kits include; Weight of doe before service (WBS): This was carried out using a weighing scale of 10kg capacity, Date of service (DSV) was recorded as the day the doe was mated, Number of time served (NTS) was recorded as number of mating before a success was achieved, Kindling Date (KDT) was recorded as the day the doe kindled, Litter size at Birth (LSB) was carried out by direct counting of the kits immediately after kindling including the number of still births, Litter weight at Birth (LWB) was carried out by weighing each litter in an electronic weighing scale immediately after kindling, Litter size at weaning (LSW) was carried out by counting the number of kits in each litter at 4 weeks, Litter weight at weaning (LWW) was carried out by weighing each litter in a weighing scale of 5kg capacity at four weeks of age, Pre-weaning percentage mortality was calculated from the number of kits mortality as; $\frac{\text{number of dead kits}}{\text{litter size at birth}} \times 100$, Weekly body weight from weaning to adult was monitored using weighing scale of 5kg capacity,

Gestation length (GLT) was read as the difference between date of last mating and kindling date, Daily feed intake was determined by subtracting feed consumed from feed given, Total weight gain was calculated by subtracting initial weight from final weight, Feed conversion efficiency (FE) determined by weight gain divided by feed intake as FE $\frac{\text{weight gain}}{\text{feed intake}}$, Average daily gain (ADG) was calculated as final weight minus initial weight divided by age (days). Expressed as ADG $= \frac{W_F - W_0}{\text{Age (days)}}$, Feed per kg gain is calculated as average daily feed intake (ADFI) divided by average daily weight gain (ADG). This was expressed as F/kg gain $= \frac{\text{ADFI}}{\text{ADG}}$.

2.4. Experimental Design

The experiment was conducted using a Completely Randomized Design (CRD) with a statistical model depicted as;

$$Yij = \mu + ti + eij$$

Where;
Yij = the observed value
μ = general mean of the population
ti = fixed effect of the weight at first service (i =1, 2, 3, 4)
Wij = random error term associated with the weight observed in the i^{th} animal assumed to be NID ($X, \delta^2 = 0$)

2.5. Statistical Analysis

Data obtained were subjected to analysis of variance using the R Statistical package, version 3.3.3 (2017). Mean performances were determined and significant means were separated using the Duncan Multiple Range Test of the same package.

3. Results

The mean values for the variables studied are presented in Table 1. The rabbits showed significant performance in all the variables considered except in LSB. Group 4 rabbits had the highest values in all the variables except in LSB, LWB, and NTS. Group 1 had the highest pre-weaning mortality of 23.25% followed by Group 2 which had 1.50%. Group 4 had the longest gestation length which recorded zero mortality.

Table 1. *Effect of Weight on Productive and Reproductive Traits.*

Parameters	Weight Groups				
	1	2	3	4	SEM
LSB(no.)	4.30 ±0.30	4.00 ±0.15	4.10 ±0.20	4.14 ±0.55	0.12
LWB(g)	40.08 ±1.04^{c}	43.83 ±2.16^{b}	49.26 ±2.93^{a}	45.57 ±3.74^{ab}	1.48
LSW(no.)	3.20 ±0.29^{c}	3.28 ±0.16^{c}	3.67 ±0.20^{b}	4.14 ±0.55^{b}	0.12
LWW(g)	366.2 ±26.92^{b}	373.1 ±14.02^{b}	366.00 ±16.49^{b}	422.9 ±29.74^{a}	9.64
SB (%)	2.32 ±0.10^{c}	8.50 ±0.11^{b}	10.48 ±0.18^{a}	0.00 ±0.00^{a}	0.08
GL(days)	31.20 ±0.20^{b}	30.92 ±0.04^{b}	30.53 ±0.09^{a}	32.14 ±0.40^{c}	0.06
PWM (%)	23.25 ±0.33^{b}	1.50 ±0.03^{a}	0.00 ±0.00^{a}	0.00 ±0.00^{a}	0.05
NTS(no.)	1.40 ±0.16^{a}	1.32 ±0.07^{a}	1.13 ±0.06^{b}	1.29 ±0.18^{ab}	0.05

Values are Least means (± sem)
^{abc} Means with different superscripts within the same parametric row differ significantly. ($p<0.05$)
Weight Groups: 1=1 to 1.49kg, 2=1.5 to 1.99kg, 3=2 to 2.49kg, 4= 2.5kg and above
LSB= litter size at birth, LWB= litter weight at birth, LSW= litter size at weaning, LWW= litter weight at weaning, GL= gestation length, STBT= stillbirth, PWM= pre-weaning mortality, NTSV= number of time served

Data on the means of the growth performance of New Zealand White rabbits of different weight groups at first service are presented in Table 2. The initial weight was significantly ($P<0.05$) highest in weight group 4 and least in group 3 The final weight was highest in weight group 4 with a mean value of 1.657 Kg and least in groups 1 and 2 (1.631 Kg) each. The total weight gain was highest in weight group 1 and the least in group 4. The highest daily weight gain was observed in group 1, with a mean weight of 9.04 and the least was in group 4 (8.67). Although, they were not significantly ($P>0.05$) different. The total feed intake was highest in weight group 4 with the mean value of 1.486 kg and the least in group 3 (1.418 kg). The daily feed intake was highest in weight group 4 and least in group 3. The feed per kg weight ranged from

1.15 g in group 3 to 1.23 g in weight group 4. The feed conversion efficiency (FE) ranged from 0.82 in group 4 to 0.89 in groups 1 and 3.

Table 2. *Efficiency of Gain of offspring of New Zealand White rabbits of different body weight groups.*

Parameters	Weight groups				
	1	2	3	4	SEM
Initial weight(g)	366.2[b]	373.1 [b]	366.0 [b]	442.9 [a]	9.64
Final weight(kg)	1.631	1.631	1.619	1.657	24.71
Total weight gain(kg)	1.265	1.258	1.253	1.214	23.40
Daily weight gain(g)	9.04 [a]	8.98 [b]	8.95 [b]	8.67 [c]	0.17
Feed intake(g)	1433	1463	1418	1486	18.55
Daily f. intake(g)	10.23	10.45	10.13	10.62	0.13
Feed/kg weight(g)	1.16 [b]	1.19 [b]	1.15 [b]	1.23 [a]	0.02
FE	0.89 [a]	0.86 [b]	0.89 [a]	0.82 [c]	0.01
Mortality (%)	23.25[a]	1.50 [b]	0.00 [c]	0.00 [c]	0.05

abc Means with different superscripts within the same parametric row differ significantly. ($p<0.05$) *Weight Groups: 1=1 to 1.49kg, 2=1.5 to 1.99kg, 3=2 to 2.49kg, 4= 2.5kg and above* SEM= standard error of mean, FE= feed conversion efficiency

4. Discussion

Live weight plays an important role in determining several characteristics of animals. The results obtained for rabbits from does in group 4 had the best weaning weight. This aligned with the findings of [9]. Bello-Onaghise and Orheruata also reported a similar value of 0.47±0.09 kg for litter weight at the weaning of composite rabbits [4]. Litter weight at birth (LWB) was highest in group 3 with a mean of 49.26g while the lowest value was recorded in group 1 (40.08). This also agrees with the findings of [7]. An average litter weight at birth of between 38.95 and 43.56 g was also reported by [17]. These values were in line with the results of this study. It implies that the populations of rabbits in Nigeria are more of the New Zealand bloodline. The slight variation in the values could be attributed to differences in body weight at first service.

The gestation length (GL) values obtained in this study were in line with what has been reported in the literature. Values between 29 to 33 days were reported by [15]**.** 28.10 to 30.40 days and 29.92 days were reported for some breeds of rabbits in Southern and Northern Nigeria [14]. In this study, 30.53 to 32.14±0.40 days were obtained. Slight variation in values could be ascribed to breed differences, location, feeding regime, and other management strategies involved. The results however suggested that GL was species-specific since reported values were within the same range.

The highest pre-weaning mortality of 23.25% was recorded in group 1, with other groups having zero percent except group 2 which had 1.50% suggesting that heavier rabbits at first mating had better mothering ability with no or little stillbirths as against lighter rabbits. Stillbirths ranged from 2.32% in group 1 to 10.48% in group 3, while stillbirth was however not observed in group 4. The values reported were in agreement with values reported by [10] who recorded an estimated lower limit of 5 to 7% of young as stillborn and another 16-20% before weaning. However, [3] reported lower values of stillborn ranging from 0.01 to 0.24%. Pre-weaning mortality can be attributed to the unstable nature of the climatic condition, poor mothering ability, and death of the dam. A similar observation was made by [19]. The number of time served ranged from 1.13±0.06 in group 3 to 1.40±0.16 in group 1. This agreed with [8] who also reported similar values of 1.26 to 1.36 services per conception.

The results of the performance of New Zealand White rabbits concerning initial weight, daily weight gain, feed per kg weight, feed conversion efficiency, and percentage mortality showed significant influences. The values reported for daily weight gain agreed with the values of 8.40 to 13.38 g reported by [11], but the lower limit was higher than 3.65 to 9.57 g reported by [16] and 4.72 to 6.94 g by [20]. The total weight gain was however higher than the values of 437.08 to 749.22 g reported by Makinde (2016). However, the final weight recorded agreed with the findings of [11] who reported 1.35851 Kg to 1.66522 Kg but were higher than the value of 1.333 Kg to 1.600 Kg reported by [1]. Similarly, the average daily feed intake obtained in this study was relatively lower

than 41.7 ±2.45 to 50.5 ±2.26 g reported by [12] and 24.21 to 45.15 g reported by [20].

The feed efficiency is a key indicator to assess the performance of a farming system. The feed conversion efficiency (FE) recorded in this study was relatively lower than the 4.50 to 4.73 value of the feed conversion ratio reported by [2] and 3.7 and 4.5 reported by [12]. Differences in the feed conversion could reflect differences in the efficiency of feed utilization by different breeds/genotypes, and period of experiments. In this study, rabbits in groups 1 and 3 had a better FE. This implied that rabbits in these weight groups have a better efficiency in converting feeds. Suggesting that offspring from lighter does have better FE.

The values recorded for the mortality rate agreed with the findings of [11] who reported a mortality of 0 to 1. The values of total feed intake were lower than the values of 2664.46 g to 3185.51 g reported by [11]. The breeds, initial weights, diets, and duration of the experiment could be among the factors that were responsible for the differences in final live weight and total feed intake of the rabbits.

5. Conclusion

From the foregoing, it is therefore recommended that farmers take advantage of breeding primiparous does at a body weight of 1.00 - 1.49 kg (group 1) or 2.00 - 2.49 kg (group 3) since these body weight groups had better performance but for the high mortality in group 1, it will be better to mate rabbits for the first time at body weight of 2.00 - 2.49 kg (group 3).

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Authors' Contribution

The experiment was conducted by O C. O; O A. M did the design and data analysis while BO. G monitored the health condition of the experimental animals throughout the experiment.

Conflicts of Interest

There is no conflict of research interest among the authors.

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