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Genetics and Breeding

Growth, survival rate of New Zealand White, Dutch Rabbit and their crosses

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Abstract. *The aim of the study was to assess survival rate of crossbred New Zealand White and Dutch rabbit breed. A total of 16 mature rabbits of seven to nine months old, New Zealand White and Dutch were used for the study. Data obtained were subjected to analysis of variance ANOVA using SAS. The reproductive traits studied were litter size, litter birth weight, mean kit weight. The growth traits were: body weight, body length, ear length, chest circumference, hind limbs, thigh length, nose to shoulder and thigh circumference. The reproductive traits were significantly ($P<0.05$) affected by genetic group Pure and crosses. New Zealand White observed high litter size and litter birth weight at first, seventh, 14th and 21st day. Purebred Dutch had significant ($P<0.05$) high values for growth traits. The body weight 478.73±18.10, body length 33.12±0.42, ear length 9.10±0.09, chest circumference 18.24±0.45 and hind limbs 19.51±0.33 were significantly ($P<0.05$) high in crosses of Dutch x New Zealand White. Pre-weaning mortality and survival rate at weaning were 22.22% and 77.77% high in New Zealand White; 14.28% and 85.71% in Dutch and DUC x NZW; and 9.09% and 90.90% in NZW x DUC. In conclusion, New Zealand White x Dutch crosses demonstrated high survival rate and low pre-weaning mortality.*

Keywords: breed, crossbreed, litter trait, pre-weaning, mortality

Introduction

Protein deficiency can be alleviated through animal production and rabbit has immense potentials such as short gestation period and high nutritional quality meat (Ajala and Balogun, 2004). The rabbit possesses good characteristics, thus, are as follows; high growth rate, high prolificacy relatively low cost of production, sodium and cholesterol (Esfandyari et al., 2015). Consumption of protein especially from animal source such as ruminants e.g. sheep, goat, cattle and monogastric animals poultry and swine are insufficient (Owen et al., 2008). However, it is important to look into other alternative source of bridging the gap of protein deficiency in Nigeria (Owen et al., 2008). Less consumption of protein from animal source has for long afflicted many developing countries such as Nigeria (Owen et al., 2008). Human population growth in developed countries is stabilizing whereas that of developing countries, Nigeria inclusive, is still increasing rapidly. However, searching for alternative sources of protein to meet up the population challenge is imperative (Owen et al., 2008). Crossing does not only take advantage of traits with considerable non-additive genetic variation but also exploits differences between populations as a deviation from overall mean between populations (Ahmed, 2003). Crossing of rabbits which are micro-livestock plays a significant role in overcoming low protein consumption in Nigeria (Oloruntola et al., 2015). The breeder uses crossbreeding as the fast and easier way of improving body weight and morphological traits in rabbit due to hybrid vigor and complementary effect (Esfandyari et al., 2015). The quality of largescale rabbit production in commercialized way mostly lined on the litter traits such as litter size at birth and the survivability of the

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kits up to weaning stage (Odeyinka et al., 2008). Mostly, the local breeds of rabbit in Nigeria are small and take longer period to grow, express high mortality rate and low productivity due to inbreeding (Ahmed, 2003). They are more fitted in our local environment than exotic breeds. Well-planned crossbreeding experiments of these breeds can effectively resolve the problem.

Material and methods

Animals and Management

The research was conducted at the Rabbit Section, Federal College of Agriculture, Akure Ondo State, Nigeria. The area is located at latitude 7.16˚ N and longitude 5.150˚ E of the Rainforest Zone of South West Nigeria. The rainfall ranges from 1100 mm to 1,300 mm and lasts for about six to seven months. The temperature ranges between 24-35˚C while the average relative humidity is about 84% (Ovimap, 2022). A population of 16 mature rabbits (seven to nine months old) of four bucks and 12 does were sourced within Akure metropolis. The stock comprised two bucks and six does for each breed (New Zealand White and Dutch). The rabbits were kept in a well-ventilated pen with each individual on separate hutch containing water and feeding troughs. The animals were dewormed with amprolium and ivermectin injection against coccidiosis, ecto- and endoparasites, respectively. The rabbits were fed with formulated concentrate diet containing 3000ME (Kcal/kg DM) 16% CP and 18% CF and also green forage *Tridax procumbens* was also provided to the animal *ad libitum*. Routine cleaning of the hutches was done regularly. The kits were weaned at 35 days of age.

Mating Plan

The experimental mating plan of the animal is presented in Table 1. The mating ratio was 1:3. Each doe was taken individually to their sire group for mating. Thereafter, they were returned to their hutches after successful mating. Mating dates were recorded. Pregnancy was detected or observed 14 days after post coitus by palpation of uterus through the abdominal wall between the two thighs as the pregnancy progress. Does that failed to conceived were re-mated. Nest boxes were introduced in preparation few days to the kindling. The reproductive traits and pre-weaning mortality measured were recorded according to dam and their respective mated sire immediately kindling was observed.

Table 1. Experiment mating plan

Sire line	Dam line	Progeny
NZW	NZW	NZW Pure
NZW	DUC	NZW x DUC
DUC	DUC	DUC Pure
DUC	NZW	DUC x NZW

NZW = New Zealand White, DUC = Dutch

Data collection

Reproductive Traits

The litter traits measured include: Litter size (LS), Litter birth weight (LBW), Mean kit weight (MKW), and Pre-weaning mortality (PWM) which were measured at 1st, 7th, 14th, 21st, 28th, and 35th day for both pure and crossbred animals.

Litter Size (LS): The actual number of newborn kits.

Litter Birth Weight (LBW): The weight of the litters at birth measured in grams using a sensitive scale.

Mean Kit Weight (MKW): The weight of the kits divided by the number of kits measured in gram using a sensitive scale.

Pre-weaning Mortality (PWM): This is the number of dead kits before weaning expressed as percentage as:

$$\text{PWM\%} = \frac{\text{Total Liter Size at Birth} - \text{Alive Kits Number at Weaning}}{\textit{Total Litre Size at Birth}}\ x\ 100$$

Survival Rate at Weaning (SRW): Taken in percentage which was calculated as follows:

$$\text{SRW} = \frac{\text{Litter size at weaning}}{\textit{Litre Size at Birth}}\ x\ 100$$

Growth traits

Body weight (BW): This was measured in grams (g) using a digital weighing scale (Mettler Toledo®, Top Pan Sensitive Balance, J. Liang Int. Ltd. U.K).

Linear body traits were determined in centimeters (cm) using flexible (tailoring) tape at two weeks intervals for a period of 8 weeks. They were measured in line with anatomical reference points described by Akinsola (2012) which include:

Ear length (EL): Measured from the ear based to the zygomatic arch of the ear.

Body Length (BL): Diagonal distance from the point of shoulder to point of hip bone or first thoracic vertebrae

to base of tail.

Hind limb (HL): Distance from the hip joint region to the tip of the claw.

Thigh Length: Distance from the first joint between the pelvic to the knee region.

Nose to Shoulder: Distance from the point of the nose to the shoulder (fore limb).

Chest circumference (CC): This refers as circumference of the heart between the forelimbs

Thigh circumference (TC): Circumference of the thigh

Statistical analysis

Data obtained were put through analysis of variance (ANOVA) using General Linear Model (GLM) of SAS (2002). The means of the litter and growth traits that were significant were separated using Duncan Multiple Range Test (DMRT) of SAS (Duncan, 1955).

For the estimation of litter traits, the following parameters were considered; Litter size (LS), Litter birth weight (LBW) and Mean kit weight (MKW) at 1st, 7th, 14th, 21st and 35th days of age.

Results and discussion

Table 2 shows the least square means (±SE) of litter traits in pure and crossbred rabbit breeds. The values of litter traits observed were significantly (P<0.05) affected by crosses. The litter size and litter birth weight at 1st, 7th, 14th and 21st days of age were significantly (P<0.05) high in favor of New Zealand White (pure bred). However, the mean kit weight was higher estimated in pure bred Dutch. New Zealand White x Dutch (NZW x DUC) hybrids had higher values for litter birth weight at 28 and 35 days of age (1262.50±32.50 and 1632.50±22.50, respectively). Least values were observed in Dutch x New Zealand White (DUC x NZW) hybrids from birth to weaning. Purebred New Zealand White rabbit performed better values for litter size and litter birth weight at birth to 21st day. This could be attributed to variation in genetic makeup among breeds used. The observed high litter size of 6.09 at birth in New Zealand White could be due to different biological components (ovulation rate and pre-implantation viability) among the breeds as the causes of variation in litter size at birth and at weaning. Iyeghe-Erakpotobor et al. (2001) suggest that litter weight among rabbit breeds are the major causes of variation in litter size at birth and alive at birth. Environment, climatic condition (ambient temperature and relative humidity) and season of the year usually posed a significant effect on reproductive traits and this could be responsible for the low litter size in Dutch and crosses. Bhatt et al. (2002) reported that litter size and weight at birth and weaning were higher during winter as compared to those during summer and the rainy season.

Table 2. Least square means (±SE) of litter trait in pure and crossbred rabbit breed

		Pure bred		Crossbred	
Days	Trait	NZW	DUC	NZW x DUC	DUC x NZW
1	LS	6.09±1.73^{a}	3.50±1.50^{c}	5.50±1.50^{b}	3.50±1.50^{c}
	LBW(g)	271.3±16.74^{a}	202.50±27.50^{c}	217.50±32.50^{b}	147.50±27.50^{d}
	MKW(g)	56.27±11.98^{b}	57.91±0.41^{a}	43.96±2.29^{d}	51.87±8.12^{c}
	LS	5.33±1.20^{a}	3.00±1.00^{c}	5.00±1.00^{b}	3.00±100^{c}
7	LBW	513.33±87.09^{a}	431.50±48.50^{c}	485.00±20.00^{b}	405.00±15.00^{d}
	MKW	99.56±7.42^{c}	156.25±36.25^{a}	100.21±16.04^{c}	150.00±45.00^{b}
	LS	5.33±1.20^{a}	3.00±1.00^{c}	5.00±1.00^{b}	3.00±1.00^{c}
14	LBW	748.33±21.51^{a}	662.50±67.50^{c}	710.00±20.00^{b}	615.00±15.00^{d}
	MKW	146.62±15.20^{c}	240.00±57.50^{a}	147.08±25.41^{c}	232.50±82.50^{b}
	LS	5.33±1.20^{a}	3.00±1.00^{c}	5.00±1.00^{c}	3.00±1.00^{c}
21	LBW	964.99±12.1^{a}	832.50±47.50^{c}	945.50±10.50^{b}	752.50±37.50^{d}
	MKW	196.89±37.55^{c}	306.25±8.25^{a}	197.42±41.57^{c}	277.50±80.00^{b}
	LS	5.00±1.00^{a}	3.00±1.00^{c}	5.00±1.00^{b}	3.00±1.00^{c}
28	LBW	1166.66±26.50^{b}	1010.00±25.00^{c}	1262.50±32.50^{a}	907.50±57.50^{d}
	MKW	245.28±29.93^{c}	363.12±79.37^{a}	218.87±13.87^{d}	320.62±54.37^{b}
	LS	4.66±0.88^{b}	3.00±1.00^{c}	5.00±1.00^{a}	3.00±1.00^{c}
35	LBW	1356.66±22.77^{b}	1322.50±87.50^{c}	1632.50±22.50^{a}	1135.00±27.00^{d}
	MKW	294.05±8.91^{d}	485.00±13.50^{a}	345.21±95.54^{c}	391.25±38.70^{b}

Means with different superscript on the same row are statistically different (p<0.05). NZW = New Zealand white; DUC = Dutch; LS = Litter size; LBW = Litter birth weight; MKW = Mean kit weight; SE = standard error

Table 3 shows the least square means (±SE) of growth traits for pure and crossbred rabbits. The growth traits were significant (P<0.05) in both pure and crosses. Dutch had high body weight 545.68±28.44 g, hind limb 20.38±0.26 cm, nose to shoulder 11.96±0.29 cm and thigh circumference 9.94±0.40 cm. The estimates of body length, ear length and chest circumference were not significant between Dutch and Crosses of DUC x NZW. Dutch performed high growth traits. The differences on estimates for growth traits observed between the pure breed and crosses demonstrated that progeny growth traits are influenced by both genetic (e.g. breed) and litter size at birth. Ologbose et al. (2017) reported high values of body weight in purebred Dutch. The body length, ear length and chest circumference estimated in crosses of DUC x NZW suggest high role of additive genetic effect in the expression of these traits due to hybrid vigor. Esfandyari et al. (2015) suggested that crossbreeding is the fast and easier way of improving body weight and morphological traits in rabbits due to hybrid vigor and complementary effect.

Table 3. Least square means (±SE) of growth trait for pure and crossbred rabbit

	Breed			
Traits	NZW	DUC	NZW x DUC	DUC x NZW
BW (g)	398.43±13.19^{c}	545.68±28.44^{a}	405.90±18.97^{c}	478.73±18.10^{b}
BL (cm)	30.87±0.36^{b}	33.25±0.63^{a}	30.90±0.65^{b}	33.12±0.42^{a}
EL (cm)	8.92±0.11^{b}	9.70±0.17^{a}	8.59±0.13^{b}	9.10±0.09^{a}
CC (cm)	16.62±0.25^{b}	18.86±0.46^{a}	17.14±0.35^{b}	18.24±0.45^{a}
HL (cm)	19.01±0.24^{b}	20.38±0.26^{a}	18.44±0.36^{c}	19.51±0.33^{b}
THL (cm)	11.51±0.15	12.31±0.26	11.26±0.25	11.98±0.26
NTS (cm)	10.37±0.15^{b}	11.96±0.29^{a}	10.65±0.17^{b}	11.75±0.23^{b}
TC (cm)	8.68±0.15^{b}	9.94±0.40^{a}	8.39±0.20^{b}	8.80±0.25^{b}

Means with different super script on the same row are statistically different (P<0.05). NZW=New Zealand White, DUC= Dutch, BW=Body weight, BL=Body length, EL=Ear length, CC=Chest circumference, HL=Hind limb, THL=Thigh length, NTS=Nose to shoulder, TC=Thigh circumference

Table 4 shows survival rate of pure and crossbred rabbit. New Zealand white recorded high pre-weaning mortality (PWM) of 22.22% and low survival rate at weaning (SRW) 77.77%. The crosses of New Zealand White x Dutch (NZW x DUC) had lower pre-weaning mortality of 9.09% and high survival rate at weaning 90.90%. Environmental stress, management practices and inbreeding could be the causes of high pre-weaning mortality and low survival rate at weaning in New Zealand White. Mortality in rabbit generally has been attributed to the climatic conditions (Sivakumar et al., 2013). Olowofeso et al. (2012) estimated a range of 13.7 to 46.8% pre-weaning mortality in rabbit. Low pre-weaning mortality and higher survival rate observed in cross of New Zealand White x Dutch could be due to heterosis (hybrid vigor) as a result of increase in heterozygosity in offspring.

Table 4. Survival rate of pure and crossbred rabbit

Breeds	Litter size at birth	Litter size at weaning	PWM (%)	SRW (%)
NZW	18	14	22.22	77.77
DUC	7	6	14.28	85.71
NZW x DUC	11	10	9.09	90.90
DUC x NZW	7	6	14.28	85.71

NZW=New Zealand White; DUC= Dutch; PWM=Pre-weaning mortality and SRW= Survival rate at weaning

Conclusion

Crossbreeding improved the heterotic value of the survival rate trait which is generally low in heritability due to increase in genetic diversity amongst the offsprings born, hence, New Zealand White and Dutch (NZW x DUC) crosses observed high survival rate and low pre-weaning mortality compared to their counterpart. While crossbred between Dutch and New Zealand White had higher body weight and body length.

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