ESTIMATION OF HETEROSIS AND HERITABILITY OF BODY WEIGHT IN PROGENIES OF CROSSES BETWEEN TWO BREEDS OF RABBITS

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ABSTRACT
This study was conducted with New Zealand White (NZW) and Dutch Black (DTB) breeds of rabbits' crosses to estimate heterosis and heritability. Forty-eight (48) rabbits, comprising twelve (12) bucks (6 per breed) and thirty-six (36) does (18 per breed) were used in the mating ratio of 1:3. Parameters taken on both the parents and their progenies according to the different breeding groups include Body Weight (BW) and Body Length (BL). The measurements were taken at 4, 8, 12 and 16 weeks of age. The results revealed negative heterosis of -1.90% and -4.34% at 4th and 12th week for NZW x NZW, -2.58% at 8 weeks for DTB x DTB, while NZW x DTB and DTB x NZW yielded positive heterosis of 2.22%, 20.96%, 15.96% and 5.30% at week 4, 8, 12 and 16 respectively. Heritability estimates from the body weight were generally low to moderate at 4th to 8th weeks for all the crosses. Conversely, at 12th week heritability estimates were high, 0.68±0.15, 0.44±0.15, 0.50±0.39 and 0.56±0.53 for NZW x NZW, DTB x DTB, NZW x DTB and DTB x NZW respectively. It could be concluded from this study that using the DTB to sire DTB x NZW crossbred progeny in rabbit breeding programme can yield considerable hybrid vigour.
Key words: Rabbits, crossbreds, heterosis, heritability and hybrid vigour.

INTRODUCTION
Rabbit is in the class of micro livestock that provides alternative to meat production instead of the traditional use of cattle, sheep and goat. It has gained much prominence in recent times due to its prolificacy, comparatively low production cost, and no religious restriction (Ansah *et al.,* 2014). Rabbit has been used as an experimental animal in genetics and reproductive physiology since the beginning of the century. It was not until 1950 that first findings on quantitative genetics were published, about the maternal influence on birth weight in rabbits, and research on the genetic improvement of the rabbit for meat production (FAO, 1997). Rabbits are characterized by high reproductive ability with a short generation interval and so can produce a high quantity of meat in a short period (Zerrouk *et al*., 2005). Rajendra (2000) opined that rabbits are highly prolific and are 2.5 and 4 times more efficient in extracting protein from forages than sheep and beef cattle, respectively. This study seeks to exploit all the hybrid vigour thereby improving genetically the production traits of rabbit for mankind.

Crossbreeding is one of the tools with which the breeder improves his animals. That is why Apori *et al.,* 2014) observed that crossbreeding has offered a much better alternative for improving on the growth rate and litter size of some chosen rabbits. One major challenge in crossbreeding exercise is the choice of the breed to serve as sire or dam line, hence we rely on reciprocal crossing (Hagon and Opoku-Mensah, 2019). Reciprocal effect is the deviation between crosses of two parental lines in which their roles were reversed.

In Nigeria today, there is need to diversify our animal production from the natural cattle, sheep, goat, swine and poultry to micro livestock animals like rabbit so as to fulfill the ever-growing demand for animal proteins. A person with one pair of rabbits can produce 60 to 80 rabbits each year to eat or sell (Elmer, 1990). It is no longer secret that most Nigerians struggle for meat in any gathering which exposes their scarcity of meat. Besides, the minimum animal protein requirement according to World Health Organization is 35g per head per day, but an average Nigeria animal protein intake is as low as 6.5g per head per day (FAO, 2005). In addition, genetic improvement of rabbit is important in order to increase their contribution to the much-needed animal protein. One of the pre-requisites for genetic improvement is knowledge of genetic parameters for important economic traits (Akanno and Ibe, 2005). It is very unfortunate that the information on these parameters is scanty in available literature for rabbits raised in the tropics. Buchanan and Northcutt (2011) observed that heterosis or hybrid vigour is a difference between the hybrid and the mean of the two parents and it is often called midparent heterosis. It is therefore a measure of the superior performance of the crosssbred relative to

average of the pure breed parents involved in the cross. The probable cause of most heterosis is due to combining genes from different breeds, concealing the effects of the inferior genes. This is very important to a farmer in exploiting parents to achieve a better offspring.

MATERIALS AND METHODS

The study area

The study was carried out at the Rabbitry unit of the Teaching and Research farm, Department of Animal Science, University of Nigeria, Nsukka

Experimental animals and management

A total of forty eight (48) rabbits, comprising twelve (12) bucks (6 per breed i.e. 6 New Zealand White Bucks and 6 Dutch Black Bucks) and thirty six (36) does (18 per breed i.e. 18 New Zealand White does and 18 Dutch Black does) were used and assigned into the experimental hutch cages at mating ratio of 1:3.

Routine hygiene was maintained especially during kindling. The nest box was checked regularly to remove any dead animals during parturition. The newly born rabbits were weighed and weaning age was 28 days or a month. Commercial feed (vital growers feed, CP= 15% min, fat 7% max, CF=10% min, available phosphorus = 0.35% min and metabolizable energy = 2550Kcal/kg minimum) was used throughout the experiment as the concentrates. Forages-grasses and legumes like *Panicum maximum*, *Centrosema pubescens*, *Ageratum conizoides*, *Aspilia africana* and *Andropogon gayanus* were used throughout the experiment as supplementary ration.

Percentage heterosis = (crossbreed average- pure breed average/ Pure breed average) x 100.

Heritability (h^2) (narrow sense) is the measure of additive genetical variation in proportion to the phenotic variation for a trait expressed in a rabbit population (Mahmoud, 2008).

Experimental design and statistical analysis

The statistical package used was Statistical Product and Service Solutions (SPSS) in which variance components from the procedures of analysis of variance (ANOVA) were used to estimate heritability.

The statistical design was the nested (hierarchical) design in which each sire was mated to 3 dams and each mating resulting in number of progenies. The model **was as shown below:**

$Z_{ij} - \alpha_i = \mu + \beta (X_{ij} - \bar{x}) + E_{ij}$ (Beker, 1992).

Where:

Z_{ij} = is the mean of the records of the offspring from a mating ofi-th sire to the j-th dam;

μ = common mean;

α_i = the effect of the i-th sire;

β = the regression co-efficient of Z on X;

X_{ij} = the record on the j-th dam mated to the i-th sire;

$\bar{x}$ = the phenotypic mean of the dams; Eij = the deviation of the means of the progeny.

The regressions from the sire families are pooled to obtain the common regression co-efficient, β.

Sire effect was removed by obtaining the regression of offspring on dam within the sire.

RESULTS AND DISCUSSION

Table 1: Estimation of heterosis for the different breeding groups at different weeks.

Weeks	Pure crosses		Main crosses	Reciprocal
	NZW x NZW	DTB x DTB	NZW x DTB	DTB x NZW
4	-1.90%	2.58%	12.12%	2.22%
8	5%	-2.58%	4.28%	20.96%
12	-4.34%	2.58%	5.55%	15.46%
16	5.56%	9.09%	1.92%	5.30%

Key: NZW = Newzeland white, DTB = Dutch black

Table 1 above shows the estimate of heterosis from the mid-parent method. There were negative heterosis for body weight of -1.90% at 4th week and -4.34% at 12th week for the pure crosses (NZW). There was also a negative heterosis of -2.58% at 8th week for the pure crosses of (DTB). The main crosses and reciprocal crosses of NZW and DTB yielded positive heterosis for body weight especially the reciprocal crosses of DTB x NZW which yielded 2.22%, 20.96%, 15.96% and 5.30% at week 4, 8, 12 and 16 respectively. This result was similar to Ibe *et al*. (2005) who reported 5% and 5.81% heterosis for body weight for a crossbreed of New Zealand White rabbit and Dutch black, Chinchilla and Dutch rabbit crosses respectively. This supports the fact that non-additive effects of genes could be exploited by crossbreeding for body weight. This shows that, apart from selection for economic improvement for traits highly heritable, crossbreeding method is an asset to achieve the same goal. This result also is similar with that of Fayeye (2013) who reported that the percentage heterosis for litter size in local white x local brown crossbred rabbits were positive at the 7th, 14th and 21st day postpartum (+24.20%, +31.63% and + 22.94% respectively). Similarly, Yousset *et al*. (2008) showed a direct heterosis of 24 and 28 percent for litter size at birth and at weaning age in crossing v-line and Baladi Red rabbits.

Table 2: Heritability estimates of body weight (BW(g)) of the breeding groups. Breeding groups and their h^2± S.E (h^2).

Weeks	NZW x NZW	DTB x DTB	NZW x DTB	DTB x NZW
4	0.17±0.48	0.17±0.46	0.10±0.25	0.27 ±0.32
8	0.01± 0.37	0.01±0.37	0.32±0.44	0.23±0.36
12	0.68±0.15	0.44±0.15	0.50±0.39	0.56±0.53
16	NE	NE	NE	NE
Mean ($\bar{x}$)	0.29±0.33	0.21±0.33	0.31±0.36	0.35±0.40

Key**:** BW (g) = Body weight in (g), h^2 = Heritability, NE =negative variance, S.E (h^2) = Standard error of heritability

Table 2 shows the heritability estimates of the body weight of the breeding groups at various weeks. At 4th week (the weaning age), all the groups recorded low heritability for body weight except the reciprocal crosses (DTB x NZW) which recorded a moderate heritability of 0.27. The implication of low heritability is that variation due to additive gene action is probably small or that the non-additive gene action (dominance, over dominance and epistasis) may be more important than additive and environmental factors. Low heritability here could be that at this age (4th week), all the genes have not fully expressed themselves. However, Rojan (2009) obtained a moderate heritability 0.38±24 at 4th week. However, at 12th week, all the breeding groups yielded high heritability of 0.68, 0.44, 0.50, and 0.56 respectively. The implication of high heritability is that additive gene effect was stronger than the non- additive gene effect, epistasis or even environmental factors and that at this age crossbreeding aim was very much achieved.

At 16th week however, heritability could not be estimated. This was as a result of negative offspring variance components in the analysis of covariance. That is, pooled offspring weight was less than that of parent (dam). Negative variance components are regarded as an indication of the negligible contribution of additive genes to variation of the traits concerned. This could be that there was a negligible contribution of additive gene effect or that environmental factors seem to take the lead in the interplay between the genes and the environment

CONCLUSION

In this study, there was a positive heterosis for body weight especially among the crossbred.
Therefore, the potentials of crossbreeding to tap the non-additive genes for improvement of economic traits were seen in this study. The high heritability estimates at week 12 for all the breeding groups had been implicated on the age of the animals.

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