Online Journal of Animal and Feed Research
Volume 4, Issue 3: 51-59 (2014) ISSN 2228-7701

THE GROWTH AND REPRODUCTIVE PERFORMANCE OF DIFFERENT BREEDS OF RABBITS KEPT UNDER WARM AND HUMID ENVIRONMENTS IN GHANA

S.O. APORI [1], J.K. HAGAN [1], D. OSEI [2]

[1] *Department of Animal Science, University of Cape Coast, Ghana*
[2] *Animal Research Institute, Council for Scientific and Industrial Research, Ghana*

*E-mail: kofihagan30@gmail.com

ABSTRACT: The potential of rabbit production in solving the problem of inadequate animal protein supply cannot be overemphasized. A study was therefore conducted to assess the growth and reproductive performances on 488 bunnies and 87 does of Blue Vienna and 474 bunnies and 80 does of Chinchilla rabbits reared under hot and humid environment in Ghana. The reproductive performance of the two breeds, in terms of litter size at birth and weaning, litter weight at birth and weaning, kindling interval, age at first kindling and gestation length as influenced by season of kindling (rainy and dry), year of kindling (2005-2012) and parity (first to sixth and over) were determined. The overall least square means for litter size at birth, bunny weight at birth, litter size at weaning, bunny weight at weaning, gestation length, kindling interval, age at first kindling, pre-weaning growth rate and post-weaning growth rate of Blue Vienna were 5.6±0.1, 51.3±0.3 g, 4.4±0.1, 601.5±0.9 g, 30.0±0.1 days, 94.7±0.4 days, 159.7±0.4 days, 13.1±0.1 g/day and 15.4±0.1 g/day respectively. Those of Chinchilla were 5.9±0.1, 54.2±0.3 g, 4.8±0.1, 601.9±0.9 g, 30.1±0.1 days, 94.6±0.3 days, 159.8±0.2 days, 13.0±0.1 g/day and 15.3±0.2 g/day respectively. Year of kindling had significant ($P<0.05$) effect on litter size at weaning, litter weight at kindling, gestation length, age at first kindling, post weaning growth rate, body weight at 14 weeks and mortality in both breeds. Season of birth on the other hand had significant effect ($P<0.05$) on litter weight at birth, gestation length and mortality in both breeds. The number of times the doe has kindled (parity) significantly ($P<0.05$) influenced all the parameters apart from kindling interval, gestation length, age at first kindling and pre-weaning growth rate performance of both breeds. The growth performances of the breeds studied were indications of their potential of being developed in future into meat types.

ORIGINAL ARTICLE
Received 13 Mar. 2014
Accepted 04 Apr. 2014

Keywords: Chinchilla, Blue Vienna, Growth, Reproduction, Litter Size, Bunnies.

INTRODUCTION

According to Biobaku and Dosunmu (2003) and Fayeye and Ayorinde (2003), the increasing human population especially in developing countries coupled with inadequate supply of animal source of protein from the principal livestock species (cattle, sheep, goats, pigs and poultry) has made it imperative that attention be shifted to other micro-livestock such as rabbit. This is because rabbit production has the potential in alleviating the problem of inadequate animal protein supply in developing economies. This, according to Ghosh et al. (2008), is attributed largely to the rabbit's high rate of reproduction, early maturity, rapid growth rate, efficient food utilization and meat of high nutritional value. Its meat is highly digestible, wholesome, tasty, low in cholesterol, sodium and fat with high protein content (Herbert, 2011). Rabbits, because of the enormous benefits associated with their production, and with the belief that the unconventional livestock will certainly bridge the animal protein gap being experienced by man, it is imperative to give available rabbit breeds the needed attention just like other animal genetic resources so as to have more animal products that could supply the immediate needs of man.

The production efficiency of commercial rabbit farms is largely dependent on the litter size at kindling and the survivability of the bunnies up to weaning (Odeyinka et al., 2008). In addition, the pre-weaning growth is very critical in meat rabbits due to its impact on the meat produced at the finisher stage of production (Gerencser et al., 2011).

As production directly depends on reproduction, the reproductive performance of rabbits becomes an important aspect in determining the profitability of commercial rabbit breeding. Factors such as breed, season, age, and weight of females, according to Lazzaroni et al. (2012), influence the reproductive performance of animals. Among the available adaptable foreign breeds of rabbits reared for meat production in Ghana are Flemish Giant,

To cite this paper: Apori SO, Hagan JK and Osei D. 2014. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. *Online J. Anim. Feed Res.*, 4(3): 51-59.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Chinchilla, New Zealand White and California White. Over the years, attempts to introduce large scale rabbit production as poverty alleviation strategy in Ghana was limited by non-availability of accessible data for informed decision making. There is also paucity of information on the growth and reproductive efficiency of the available breeds in Ghana. Therefore, the present study was undertaken to assess the growth and reproduction performances of Blue Vienna and Chinchilla breeds as influenced by year, season and parity in order to come out with the best strategies for improving the productivity of these rabbits in Ghana.

MATERIAL AND METHODS

Location of the study

The study was carried out at a private breeding farm situated at Amanfro in the Awutu-Senya district of the Central region of Ghana. Two breeds comprising Blue Vienna and Chinchilla were studied. All the animals were reared at the farm of Farmer Brown's Livestock Farm located in the Awutu-Senya District of Ghana. The climate is generally hot, semi-arid and tropical in nature with an average annual rainfall of between 400 and 500 mm with mean annual minimum and maximum temperatures of 22^{0}C and 28^{0}C respectively.

Management of the animals

A doe and its litters were kept together in cages and fed together. The weaned rabbits were however kept in groups of four and five in standard galvanised iron cages measuring 75 X 45 X 35 cm and provided with similar management. In the mornings, concentrate mixture (16% crude protein and 2400 kcal metabolizable energy) was given at the rate of 75 g/d up to 6th wk of age and 100 g/d from 7th to 14th wk of age. For the lactating does and bunnies, a concentrate mixture of 200 to 250 g/d was given, according to their body weight and litter size. In addition, the does were supplemented with green fodder of guinea grass, *Euphorbia spp* and *Desmanthus virgatus* in the afternoons. They were provided with portable water *ad libitum*. Does and their bunnies were housed together up to weaning (i.e. 42 d). A standard prophylactic endo- and ecto-parasitic control schedule was applied. Bucks started their reproductive lives at 8 months of age and were randomly assigned to the females for natural mating. Mating was planned to avoid close relatives mating in order to reduce the level of inbreeding.

Data collection

Reproductive and growth performance records on 488 bunnies and 87 does of Blue Vienna and 474 bunnies and 80 does of Chinchilla obtained from 2005 to 2012 were used. The reproductive performance of the two breeds, in terms of litter size at birth and weaning, litter weight at birth and weaning, kindling interval, age at first kindling and gestation length as influenced by season of kindling (rainy and dry seasons), year of birth (2005 to 2012) and parity (first to sixth and over) were determined. Also the growth performance of the breeds in terms of weight at weaning, pre-and post-weaning growth rate as influenced by the environmental factors mentioned above were also determined. All bunny weights in each litter were obtained within twenty-four hours following kindling and in groups. To study the effect of season of kindling on both the reproductive and growth performance, the calendar year was divided into two seasons: the rainy season (April-November) and dry season (December-March). Age at first kindling was calculated as the age at which the doe had its first bunny. Kindling interval was also calculated as the time elapse between two successive kindling. Gestation length was estimated as period between conception and kindling. Litter size at birth and weaning was done by counting the number of bunnies per litter. On the day of kindling, gloved hand was used to pick the bunnies from one litter from the kindling box and placed on weighing scale. The litter weight was estimated as the weight of the bunnies from a particular doe. This was done by weighing the bunnies using a top-loading sensitive balance of 500g capacity. Weaning weight was taken when the bunnies were 42 days old and in this case they were weighed individually. Growth rate was calculated as the weight gained over a period. After weaning, the body weights were taken individually with a 2kg capacity sensitive top-loading balance.

Data analysis

A fixed effect model was fitted using the Generalized Linear Model (GLM) procedure of GenStat (Discovery Edition) to investigate the fixed effects of season of kindling (2 classes), year of birth (8 classes) and parity (6 classes) on the growth and reproductive performance of Chinchilla and Blue Vienna breeds of rabbits. Where differences in means were observed, the means were separated using the least significant difference at 5% level of significance. The statistical model for the birth weight and other reproductive traits was as follows:

$$Yijk = \mu + Si + Pj + Yk + eijk$$

Where Yijkl = any of the reproductive traits
μ = overall mean of the trait
Si = fixed effect of j^{th} season of kindling (1, 2)
Pj = fixed effect of k^{th} parity of doe (1, 2, 3, 4, 5, 6+)
Yk = fixed effect of l^{th}year of birth (1, 2…8)
eijk = random error associated with each observation

To cite this paper: Apori SO, Hagan JK and Osei D. 2014. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. *Online J. Anim. Feed Res.*, 4(3): 51-59.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

RESULTS AND DISCUSSION

Litter size in rabbits is regarded as one of the most important economic traits in any breed development and improvement programmes for intensive meat production. According to Moce and Santacreu (2010) most maternal lines are selected based on litter size at weaning, since this trait reflects both the prolificacy and mothering ability of the doe. The least-squares means of litter size at kindling and weaning in Blue Vienna and Chinchilla breeds are presented in Tables 1 and 3 respectively. The litter size at kindling values obtained in this present study was higher than the values obtained for similar breeds (2.7 to 4.6) under similar environments by Sivakumar et al. (2013) in India; Fayeye and Ayorinde (2010), Okuige and Okocha (2008) and Akpo et al. (2008) in Nigeria; Hasanat et al. (2006) in Bangladesh and Kumar et al. (2006) in India. They were however similar to values of 4.5 – 6.3 obtained by Oseni and Ajayi (2010) for similar breeds in Nigeria. However, other authors such as Ghosh et al. (2006), Das and Yadav (2007), Ghosh et al. (2008) and Saidj et al. (2012) have found higher values of litter size at birth and weaning in these breeds, under similar climatic conditions.

Since litter size at birth and weaning are very important economic traits, the Blue Vienna and Chinchilla rabbits in Ghana could be said to have the potential of being developed into meat types when conscious selection is applied in the populations available. The mean litter size at birth and weaning observed in the Blue Vienna and Chinchilla breeds was comparable to those found in the tropics (Iyeghe-Erakpotobor et al., 2005; Chineke et al., 2006 and Laxmi et al., 2009) under similar tropical climatic conditions of India. Litter size at weaning is an indication of the mothering ability of the doe. The higher the number of bunnies that survive to weaning, the better the mothering ability of the does since before weaning the bunnies depend solely on the doe for their nutrient requirements.

Year of kindling was found to significantly ($P<0.05$) influence litter size at weaning, age at first kindling, gestation length, post-weaning growth rate and market weight in both breeds. This agrees with the reports by Sivakumar et al. (2013), Fayeye and Ayorinde (2010), Okuige and Okocha (2008) and Akpo et al. (2008) in Nigeria, Kumar et al. (2006) and Sood et al. (2006) on similar rabbit breeds. The possible reason for the variation would probably be the differences in nutritional and management aspects during the years. There was however no clear trend with respect to the year of kindling on the parameters measured. Litter size at kindling, kindling interval and bunny weight at birth were however not significantly ($P>0.05$) influenced by year of birth, an observation which disagrees with findings by Sivakumar et al. (2013) and Sood et al. (2006).

The season of kindling had significant effect ($P<0.05$) on litter weight at birth and weaning and gestation length in both breeds. It however did not significantly ($P>0.05$) influence the other parameters studied. Authors who worked on similar breeds observed significant ($P<0.05$) effect of season on litter size at birth (Iyeghe-Erakpotobor et al., 2005). The litter weight at birth and weaning and gestation length were significantly better in the rainy season than in the dry season, an observation which was supported by the findings of Chineke et al. (2006) and Sivakumar et al. (2013). Differences in litter weight and gestation length relating to season of kindling might be due to differences in environmental and nutritional conditions (presence of available feed resources) and mothering ability. The litter weight was lower in the dry season as compared to the rainy season in both breeds, an indication of probable stressful environments during the dry season. This might have resulted in reduced feed intake by the lactating doe leading to low production of milk for the bunnies albeit reduced growth of bunnies. This agrees with the findings of Ayyat et al. (1995). Kumar et al. (2006) however reported a non-significant effect of season on gestation length for foreign rabbit breeds like Chinchilla, White Giant and New Zealand White kept in the high altitude conditions of Tamil Nadu. The influence of season on the growth and reproductive performance observed in this study might be attributed to changes in photoperiod (Hudson and Distel, 1990) during the dry and rainy seasons. The availability of quality fodder during the rainy season might have contributed to the higher performance of rabbits in this period of the year. This is because during the rainy season (April-October) the fodder was lush, having higher nutritive value with more protein and carotene content as compared to other seasons. It has been observed that higher feed intake during lactation increased both litter size and weight at birth and weaning (Pascual et al., 2003). It has been recognised that the environment plays an important role in the regulation of reproductive function and that environmental-stimuli, which acts through the nervous system and the hypothalamo-pituitary axis, can affect the reproductive physiology controlled by hormones (Theau-Clement and Mercier, 2004). These stimuli associated with the natural day-length variations, can modify the reproductive performance and the hormonal balance, consequently, the gestation length and kindling interval.

The parity of doe is the number of times a doe has kindled. In this present study, parity was found to have significantly ($P<0.05$) influenced litter size at birth and weaning, bunny weight at birth and weaning, litter weight at birth and post-weaning growth rate. According to Aksakal and Bayram (2009) the individual pre-weaning body weights are significantly lower in the 1^{st} parity born animals than in other higher parity.

An explanation of this observation is that earlier-parity animals continue to grow until reaching adult size and compete with the foetuses for available nutrients during pregnancy. Again, increased birth weight with increased parity is an indication of older dams' ability to utilize feed more efficiently to support foetal development than younger ones as reported by Aksakal and Bayram (2009) in cows. Results from the present study indicated that bunnies born in late parities were significantly ($P<0.05$) heavier than their early parity counterparts. This agrees with observations by Ouyed et al. (2011) who recorded significant effect of parity on pre-weaning bunny weight; Xiccato et al. (2004) on litter size at weaning and Das and Yadav (2007) on litter weight at birth as well as litter size and weight at weaning. In contrast, Sivakumar et al. (2013) found no significant effect ($P>0.05$) of parity on the growth and reproductive performances of similar rabbit breeds studied.

To cite this paper: Apori SO, Hagan JK and Osei D. 2014. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. *Online J. Anim. Feed Res.*, 4(3): 51-59.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Table 1 - The least mean square of the reproductive performances of Blue Vienna rabbits as influenced by year, parity and season of kindling

Effects	No	Litter size at kindling/no	Litter size at weaning/no	Litter wt. at birth/g	Bunny weight at birth/g	No	Age at first kindling/days	Kindling interval/days	Gestation length/days
Overall	488	5.8±0.1	4.4±0.1	295.6±2.1	51.3±0.3	87	159.7±0.2	94.7±0.4	30.0±0.1
Year									
2005	45	5.9±0.1	4.0 ±0.2[bc]	300.6±6.0[b]	52.1±0.8[a]	8	162.5±0.5[a]	95.2±1.0	30.4±0.2[a]
2006	55	5.8±0.1	3.7 ±0.3[c]	284.9±6.0[d]	51.9±0.9[b]	10	158.4±0.6[b]	95.0±1.0	30.2±0.2[a]
2007	60	6.0±0.1	4.9 ±0.3[a]	307.1±6.1[a]	50.9±0.9[c]	10	158.6±0.6[b]	94.5±1.0	28.4±0.3[b]
2008	60	6.1±0.1	4.5 ±0.2[a]	305.2±6.0[a]	51.2±0.9[b]	10	158.7±0.5[b]	95.4±1.0	30.0±0.2[a]
2009	75	5.9±0.1	4.4 ±0.2[a]	283.5±6.0[d]	50.7±0.9[c]	13	163.0±0.5[a]	93.3±1.0	28.8±0.2[b]
2010	60	6.0±0.1	4.5 ±0.3[a]	306.9±6.0[a]	52.5±0.9[a]	10	158.5±0.6[b]	94.7±1.0	30.2±0.2[a]
2011	67	5.9±0.1	4.1 ±0.3[bc]	291.1±6.1[c]	52.3±0.9[a]	11	159.0±0.6[b]	94.0±1.0	30.2±0.3[a]
2012	66	5.8±0.1	4.7 ±0.3[a]	285.2±6.0[d]	50.5±0.9[c]	15	159.0±0.6[b]	94.8±1.0	30.2±0.3[a]
Season									
Rainy	255	5.9±0.1	4.3±0.1	300.5±3.1[a]	51.9±0.5[a]	47	159.8±0.3	94.4±1.0	30.6±0.1[a]
Dry	233	5.8±0.1	4.5±0.1	294.8±3.0[b]	50.6±0.4[b]	40	159.7±0.3	94.9±1.0	28.6±0.1[b]
Parity									
1st	65	5.5±0.1[b]	3.8±0.2[c]	298.9±5.0[c]	50.3±0.7[c]	12		95.2±1.0	30.3±0.2
2nd	70	5.3±0.1[b]	4.3±0.2[bc]	280.3±5.0[d]	50.7±0.7[c]	16		94.9±1.0	30.1±0.2
3rd	73	5.6±0.1[b]	3.9±0.2[c]	282.5±5.0[d]	51.2±0.7[b]	13		94.4±1.0	29.8±0.2
4th	78	5.5±0.1[b]	4.9±0.2[ab]	294.0±5.1[c]	53.1±0.7[a]	14		94.9±1.0	29.7±0.2
5th	90	6.4±0.1[a]	4.4±0.2[bc]	318.1±5.3[a]	51.0±0.8[b]	14		94.8±1.0	29.9±0.2
≥6th	112	6.4±0.1[a]	5.1±0.2[a]	303.2±5.3[b]	52.6±0.8[a]	18		95.3±1.0	30.5±0.2

Means within the same column with different superscripts ([a,b,c,]) are significantly different ($P<0.05$).

To cite this paper: Apori SO, Hagan JK and Osei D. 2014. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. *Online J. Anim. Feed Res.*, 4(3): 51-59.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Table 2 - The least mean square of the growth performances of Blue Vienna rabbits as influenced by year, parity and season of kindling

Effects	No	Bunny weight at weaning/g	Pre-weaning growth wt/g/day	Bunny weight at 12 weeks/g	Post-weaning growth weight/g/day	Bunny weight at 14 weeks/kg	Mortality/%
Overall	488	601.5±0.9	13.1±0.1	1342.0±12.0	15.4±0.1	1420.0±30.0	1.5±0.1
Year							
2005	45	601.2±2.0	13.1±0.1	1467.0±32.0[a]	16.9±0.4[a]	1510.0±32.5[a]	1.9±0.2[a]
2006	55	598.2±3.0	13.0±0.1	1388.0±33.0[c]	15.9±0.4[a]	1445.0±32.6[b]	1.7±0.2[a]
2007	60	600.8±3.0	13.1±0.1	1408.0±33.4[b]	16.2±0.4[a]	1505.0±32.6[a]	1.3±0.2[b]
2008	60	603.3±2.0	13.1±0.1	1276.0±32.0[d]	14.6±0.4[b]	1355.0±32.5[c]	1.6±0.2[ab]
2009	75	601.7±2.0	13.0±0.1	1231.0±32.0[e]	14.1±0.4[b]	1350.0±32.6[c]	1.2±0.2[b]
2010	60	603.7±3.0	13.3±0.1	1407.0±32.4[b]	16.1±0.4[a]	1505.0±32.6[a]	1.6±0.2[ab]
2011	67	602.3±3.0	13.1±0.1	1269.0±33.4[d]	14.5±0.4[b]	1350.0±33.0[c]	1.5±0.2[ab]
2012	66	600.8±3.0	13.2±0.1	1292.0±33.4[d]	14.8±0.4[b]	1355.0±32.5[c]	1.1±0.2[b]
Season							
Rainy	255	601.4 ±1.0	13.1±0.0	1345.0±17.2[a]	15.4±0.2	1445.0±20.3	1.7±0.1[a]
Dry	233	602.6 ±1.0	13.0±0.0	1300.0±16.0[b]	15.3±0.2	1440.0±20.2	1.3±0.1[b]
Parity							
1st	65	597.4 ±2.0[b]	13.0±0.1	1311.0±28.0[c]	15.0±0.3[b]	1445.0±25.5[b]	2.1±0.2[a]
2nd	70	598.8 ±2.0[b]	13.0±0.1	1355.0±28.0[b]	15.5±0.3[b]	1440.0±25.3[b]	1.0±0.2[c]
3rd	73	600.8 ±2.0[b]	13.2±0.1	1267.0±28.0[d]	14.5±0.3[b]	1385.0±25.3[c]	1.7±0.2[b]
4th	78	611.8 ±2.0[a]	13.3±0.1	1300.0±28.1[c]	14.8±0.3[b]	1440.0±25.4[b]	0.7±0.2[d]
5th	90	611.4 ±2.0[a]	13.1±0.1	1478.0±29.4[a]	17.0±0.3[a]	1520.0±24.5[a]	2.0±0.2[a]
≥6th	112	618.4 ±2.0[a]	13.0±0.1	1348.0±29.4[b]	17.5±0.3[a]	1440.0±24.5[b]	1.3±0.2[cd]

Means within the same column with different superscripts ([a,b,c,]) are significantly different (P<0.05).

To cite this paper: Apori SO, Hagan JK and Osei D. 2014. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. *Online J. Anim. Feed Res.*, 4(3): 51-59.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Table 3 - The least mean square ± of the reproductive performances of Chinchilla rabbits as influenced by year, parity and season of kindling

Effects	No	Litter size at kindling/no	Litter size at weaning/no	Litter wt. at birth/g	Bunny weight at birth/g	No	Age at first kindling/days	Kindling interval/days	Gestation length/days
Overall mean	474	5.9±0.1	4.8±0.1	317.3±2.1	54.2±0.3	80	159.8±0.2	94.6±0.3	30.1±0.1
Year									
2005	50	5.9±0.1	4.5±0.2^{b}	305.4±5.8^{b}	55.7±0.9^{a}	9	163.0±0.5^{a}	95.7±1.0	30.5±0.2^{b}
2006	48	6.0±0.1	4.6±0.2^{b}	327.8±5.8^{a}	55.7±0.9^{a}	8	158.3±0.5^{b}	94.6±1.0	30.1±0.2^{b}
2007	60	6.1±0.1	5.4±0.2^{a}	329.2±5.9^{a}	55.1±0.9^{a}	10	159.0±0.6^{b}	95.7±1.0	29.1±0.2^{c}
2008	65	5.8±0.1	4.4±0.2^{b}	304.4±5.9^{b}	53.6±0.9^{b}	11	159.2±0.6^{b}	95.8±1.0	30.5±0.2^{b}
2009	65	6.0±0.1	4.7±0.3^{b}	329.1±6.1^{a}	52.6±0.9^{c}	11	162.8±0.6^{a}	94.4±1.0	29.1±0.3^{c}
2010	55	5.9±0.1	5.0±0.2^{a}	305.0±5.9^{b}	52.5±0.9^{c}	9	158.2±0.6^{b}	94.2±1.0	31.2±0.2^{a}
2011	60	5.8±0.1	4.5±0.2^{b}	305.4±5.9^{b}	53.6±0.9^{b}	10	158.7±0.6^{b}	93.9±1.0	31.3±0.2^{a}
2012	71	6.1±0.1	5.1±0.3^{a}	332.0±6.1^{a}	55.1±0.9^{a}	12	158.8±0.6^{b}	93.3±1.0	31.1±0.3^{a}
Season									
Rainy	274	6.2±0.1^{a}	4.6±0.1	323.5±3.2^{a}	55.3±0.5^{a}	46	159.9±0.3	94.1±0.5	31.4±0.1^{a}
Dry	200	5.9±0.1^{b}	4.9±0.1	312.4±2.7^{b}	53.4±0.4^{b}	34	159.7±0.3	94.9±0.5	29.9±0.1^{b}
Parity									
1st	60	5.4±0.1^{b}	4.6±0.2^{bc}	314.6±5.0^{b}	52.1±0.8^{c}	11		95.1±0.8	29.0±0.2^{c}
2nd	82	5.6±0.1^{b}	4.4±0.2^{c}	304.3±5.0^{c}	54.6±0.8^{b}	10		94.6±0.8	30.1±0.2^{b}
3rd	85	6.0±0.1^{a}	4.8±0.2^{b}	325.0±5.0^{a}	54.5±0.8^{b}	14		94.6±0.8	30.4±0.2^{b}
4th	80	6.2±0.1^{a}	5.1±0.2^{ab}	312.9±5.2^{b}	54.0±0.8^{b}	13		94.9±0.9	30.4±0.2^{b}
5th	87	6.1±0.1^{a}	5.0±0.2^{ab}	323.9±5.2^{a}	55.2±0.8^{a}	15		95.5±0.9	31.4±0.2^{a}
6th	80	6.0±0.1^{a}	5.7±0.2^{a}	325.4±5.3^{a}	55.1±0.8^{a}	17		95.4±0.9	31.9±0.2^{a}

Means within the same column with different superscripts (^{a,b,c,}) are significantly different ($P<0.05$).

To cite this paper: Apori SO, Hagan JK and Osei D. 2014. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. *Online J. Anim. Feed Res.*, 4(3): 51-59.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Table 4- The least mean square of the growth performances of Chinchilla rabbits as influenced by year, parity and season of kindling

Effects	No	Bunny weight at weaning/g	Pre-weaning growth wt/g/day	Bunny weight at 12 weeks/g	Post-weaning growth weight/g/day	Bunny weight at 14 weeks/kg	Mortality/no
Overall mean	**474**	601.9±0.9	13.3±0.1	1442.0±31.5	15.8±0.2	1445.0±30.1	1.2±0.1
2005	**50**	599.5±2.4	13.0±0.1	1473.0±31.9^{a}	14.9±0.4^{b}	1395.0±30.0^{c}	1.1±0.2
2006	**48**	602.3±2.4	13.0±0.1	1362.0±32.0^{c}	15.6±0.4^{ab}	1395.0±30.0^{c}	1.5±0.2
2007	**60**	602.9±2.5	13.1±0.1	1389.0±32.4^{c}	15.9±0.4^{a}	1445.0±30.2^{b}	0.7±0.2
2008	**65**	600.9±2.5	13.0±0.1	1309.0±32.4^{d}	14.9±0.4^{b}	1400.0±30.1^{bc}	1.4±0.2
2009	**65**	606.3±2.5	13.2±0.1	1263.0±33.4^{e}	14.4±0.4^{b}	1355.0±30.0^{c}	1.7±0.2
2010	**55**	600.1±2.5	13.0±0.1	1406.0±32.4^{b}	16.1±0.4^{a}	1495.0±30.2^{a}	0.9±0.2
2011	**60**	600.5±2.5	13.0±0.1	1251.0±32.4^{e}	14.3±0.4^{b}	1420.0±30.1^{b}	1.3±0.2
2012	**71**	602.6±2.5	13.0±0.1	1281.0±33.4^{e}	16.6±0.4^{a}	1500.0±30.1^{a}	1.0±0.2
Rainy	**274**	601.4±1.4	13.0±0.1	1372.0±17.8^{a}	15.7±0.2	1505.0±20.2^{a}	1.4±0.1
Dry	**200**	602.3±1.1	13.1±0.1	1318.0±15.1^{b}	15.1±0.2	1445.0±20.3^{b}	1.1±0.1
1st	**60**	600.2±2.1^{b}	13.3±0.1	1339.0±27.5^{b}	15.0±0.3^{bc}	1395.0±30.2^{c}	0.5±0.2
2nd	**82**	600.9±2.1^{b}	13.0±0.1	1241.0±27.5^{c}	14.5±0.3^{c}	1495.0±30.1^{a}	1.2±0.2
3rd	**85**	594.5±2.1^{b}	12.9±0.1	1348.0±27.5^{b}	15.4±0.3^{a}	1395.0±30.1^{c}	1.3±0.2
4th	**80**	596.4±2.2^{b}	12.9±0.1	1247.0±28.7^{c}	15.4±0.3^{b}	1390.0±30.1^{c}	0.7±0.2
5th	**87**	598.8±2.2^{b}	13.0±0.1	1458.0±28.7^{a}	15.5±0.3^{b}	1420.0±30.2^{b}	2.1±0.2
6th	**80**	612.4±2.2^{a}	13.2±0.1	1441.0±29.4^{a}	16.1±0.3^{a}	1505.0±30.2^{a}	1.4±0.2

Means within the same column with different superscripts (^{a,b,c,}) are significantly different (P<0.05).

To cite this paper: Apori SO, Hagan JK and Osei D. 2014. The growth and reproductive performance of different breeds of rabbits kept under warm and humid environments in Ghana. *Online J. Anim. Feed Res.*, 4(3): 51-59.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Year, season of birth and parity had a significant (P<0.01) effect on average weight of bunnies at weaning and post-weaning growth rate in both breeds (Tables 2 and 4). These results were in agreement with the findings of Sivakumar et al. (2013) and Sood et al. (2006). Bunnies kindled during the rainy season seem to show higher average body weight at kindling and weaning and post-weaning growth rate. The bigger bunny weight as the years went by could be that when the does were young they tended to reproduce lighter bunnies and as they grew they kindled bigger bunnies due to increase in body size and organs (the size of the womb) to accommodate bigger foetuses. Also increased body size influences feed nutrient intake and its attendant partitioning for growth and other production activities.

There were however no significant effect of parity on gestation length, kindling interval and age at first kindling, which disagrees with the findings of Sivakumar et al. (2013). The gestation length, kindling interval and age at first kindling values obtained in this study were within the ranges (30-32 days; 92-96 days and 157-162 days for gestation length, kindling interval and age at first kindling respectively) obtained for the same breeds by several authors (Sivakumar et al., 2013; Oke and Iheanocho, 2011; Singh et al., 2007; Kumar et al., 2006; Chineke et al., 2006; and Iyeghe-Erakpotobor et al., 2005) under similar environments elsewhere.

The seasonal effect on the early growth performance of rabbit was also reported by Kumar et al. (2001, 2006) and Sood et al. (2006). The lower litter weight at birth during the dry season could be due to the limited availability of good quality green forage to the females. Parity had a significant effect (P<0.01) on litter weight at weaning in both the breeds. Litter weight at weaning increased with parity order. This is in agreement with increase in milk production as parity order advanced (Maertens et al., 2006). Higher litter weight at birth and weaning were reported for White Giant rabbits at different parities (Singh et al., 2007) reared under sub-temperate conditions of India.

CONCLUSION

Rabbit production in Ghana is generally under the intensive system with the animals zero-grazed. The growth and reproductive performance of Chinchilla and Blue Vienna rabbits obtained under this present study were comparable to values obtained in the tropics. With the values obtained for both breeds, it is possible to develop the breeds especially the Chinchilla (due to its superior growth characteristics) into meat types in future if intense selection is undertaken. The objective of commercializing rabbit production as a means of meeting the animal protein needs of the Ghanaian populace could be realized with the current productive performance of the breeds studied. The significant effects of the non-genetic factors on the growth and reproductive performances of the rabbit breeds are indications that any future breed development strategy must take into consideration the environment so that the full genetic potential can be realized.

ACKNOWLEDGEMENT

We would like to express our heart-felt appreciation to Farmer Brown, a renowned private rabbit and grasscutter farmer in Ghana for allowing us to use his data collected over the years for the work.

REFERENCES

Akpo Y, Kpodékon TM, Tanimomo E, Djago AY, Youssao AKI and Coudert P (2008). Evaluation of the reproductive performance of a local population of rabbits in south Benin. Proceedings of 9th World Rabbit Congress – June 10-13, Verona – Italy

Aksakal V and Bayram B (2009). Estimates of genetic and phenotypic parameters for the birth weight of calves of Holstein Friesian cattle reared organically. Journal of Animal and Veterinary Advances. 8(3): 568-572.

Ayyat MS, Marai IFM and El-Sayiad GHA (1995). Genetic and non-genetic factors affecting milk production and pre-weaning litter traits of New Zealand White does under Egyptian conditions. World Rabbit Science. 3(3): 119-124.

Biobaku WO and Dosunmu EO (2003). Growth response of rabbits fed graded level of processed and un-dehulled sunflower seed. Nigerian Journal of Animal Production. 30(2): 179-184.

Chineke CA, Ikeobi CON and Ologun AG (2006). Body measurements of rabbit breeds and crosses at weaning and postweaning ages. Journal of Biological Sciences. 6(1): 31-37.

Das SK and Yadav BPS (2007). Effect of mating system, parity and breed on the reproductive performances of broiler rabbits under the agro-climatic condition of Meghalaya. Livest. Res. Rural Develop. 19. 2. http://www.cipav.org.co/lrrd/

Fayeye TR and Ayorinde KL (2003). Litter growth and weaning characteristics in two generations of straight-bred and crossbred rabbits. Nigerian Journal of Genetics 18: 68-72.

Fayeye TR and Ayorinde KL (2010). Effects of Season, Generation, Number of Mating, Parity and Doe Number of Teat on Doe and Litter Birth Characteristics in Domestic Rabbit. Research Journal of Animal and Veterinary Sciences 5: 6-9.

Gerencser Zs, Matics Zs, Nagy I, Szendrő Zs (2011). Effect of lighting schedule on production of rabbit does. World Rabbit Sci. 19: 209-216.

Ghosh M, Sil BK. Mandal L (2006). Reproductive performance of Soviet Chinchilla and Grey Giant rabbits reared under hot humid conditions of West Bengal. Indian Journal of Animal Research. 40: 52-54.

Ghosh SK, Das A, Bujarbaruah KM, Das A, Dhiman KR, Singh NP (2008). Effect of breed and season on rabbit production under subtropical climate. World Rabbit Science. 16: 29-33.
Hasanat, M.S., Hossain, M.E., Mostari, M.P. and Hossain, M.A. (2006). Effects of concentrate supplementation on growth and reproductive performance of rabbit under rural condition Bangladesh. J. Vet. Med, 4 (2): 129–132
Herbert, U. (2011). Unending seeds and waters of animal life. 12th Inaugural lecture series of Michael Okpara University of Agriculture, Umudike, Nigeria, Nov. 9, pp. 1-41.
Hudson R and Distel H (1990). Sensitivity of female rabbits to changes in photoperiod as measured by pheromone emission. J. Comp. Physiol., A, 167: 225-230.
Iyeghe-Erakpotobor GT, Oyedipe EO, Eduvie LO. and Ogwu D (2005). Effect of rebreeding interval on reproductive performance and body weight Changes of does during pregnancy. Nigerian J. Anim. Prod. 32(1): 142-152.
Kumar AR, Murugan M, Thiruvenkadan AK, Iyue M (2006). Reproduction and production traits of broiler rabbit as influenced by breed and season. Indian Vet. J. 83: 577-579.
Kumar S, Gulyani R, Kumar V, Singh RN (2001). Effect of genetic and non-genetic factors on weekly body weight of broiler rabbits in semi-arid region of Rajasthan. Indian J. Anim. Sci. 71: 1075-1077.
Laxmi JP, Ramesh Gupta B, Gnana Prakash M, Ekambaram B, Amareswari P (2009). A study on the performance of fryer rabbits under different systems of rearing. Livestock Research for Rural Development. 21: 118. Retrieved March 11, 2014. Available at http://www.lrrd.org/lrrd21/8/laxm21118.htm
Lazzaroni C, Biagini D, Redaelli V, Luzi F (2012). Technical Note: Year, season, and parity effect on weaning performance of the Carmagnola Grey Rabbit breed. World Rabbit Sci. 20: 57-60.
Maertens L, Lebas F, Szendrő Zs (2006). Rabbit milk: a review of quantity, quality and non-dietary affecting factors. World Rabbit Sci. 14: 205-230.
Moce ML, Santacreu MA (2010). Genetic improvement of litter size in rabbits. In Proc.: 9th World Congress on Genetics Applied to Livestock Production. 1-6 August, Leipzig, Germany, pp. 25.
Odeyinka SM, Oyedele OJ, Adeleke TO and Odedire JA (2008). Reproductive performance of rabbits fed Moringa oleifera as a replacement for Centrosema pubescens. 9th World Rabbit Congress Verona-Italy, June 10-13, pp. 411-416.
Oguike MA and Okocha NL (2008). Reproductive performance of rabbits re-mated at different intervals post-partum African Journal of Agricultural Research. 3(6): 412-415
Oke UK and Iheanocho VC (2011). Effect of breed and breeding system on reproductive performance of rabbits in a humid tropical environment. Tropical and subtropical Agro-ecosystems. 14: 369 – 373
Oseni SO and Ajayi BA (2010). Descriptive characterization of a Nigerian heterogeneous rabbit Population - factors affecting litter traits. World Rabbit Sci. 18: 111 – 116
Ouyed A, Rivest J and Brun JM (2011). Heterosis, direct and maternal additive effects on rabbit growth and carcass traits from a Canadian experiment. World Rabbit Sci. 19: 31 – 41
Pascual JJ, Cervera C, Blas E, Fernández-Carmona J (2003). High energy diets for reproductive rabbit does: effect of energy source. Nutr. Abstr. Rev. 73: 27- 39.
Saidj, D, Salhi O, Ain Baziz H and Temim S (2012). Effects of dietary energy content on the reproductive performance of local rabbit does. Proceedings of the 10th World Rabbit Congress – September 3 - 6, Sharm El- Sheikh –Egypt, 537 - 540
Singh U, Kumar A, Risam KS, Davendra K, Bhatt RS and Bhasin V (2007). Performance of White Giant rabbits under sub-temperate conditions. Indian Vet. J. 84: 169-172
Sivakumar K, Thiruvenkadan AK, Ramesh SKV, Muralidharan J, Anandha PSD, Saravanan R and Jeyakumar M (2013). Analysis of production and reproduction performances of soviet Chinchilla and white giant rabbits in tropical climatic conditions of India. World Rabbit Sci. 21: 101-106
Sood A., Gupta K., Risam K.S., Katoch S., Kaila O.P. (2006). Non-genetic factors affecting litter traits in Angora rabbits. Indian J. Small Rumin., 12: 102-103.
Theau-Clement, M., Mercier, P. (2004). Influence of lighting programs on the productivity of rabbit does of two genetic types. 8th World Rabbit Congress, Puebla City, Mexico, 357-364 http://www.dcam.upv.es/8wrc/
Xiccato G, Trocino A, Sartori A, Queaque PI (2004). Effect of doe parity order and litter weaning age on the performance and body energy deficit of rabbit does. Livest. Prod. Sci. 85: 239-251.