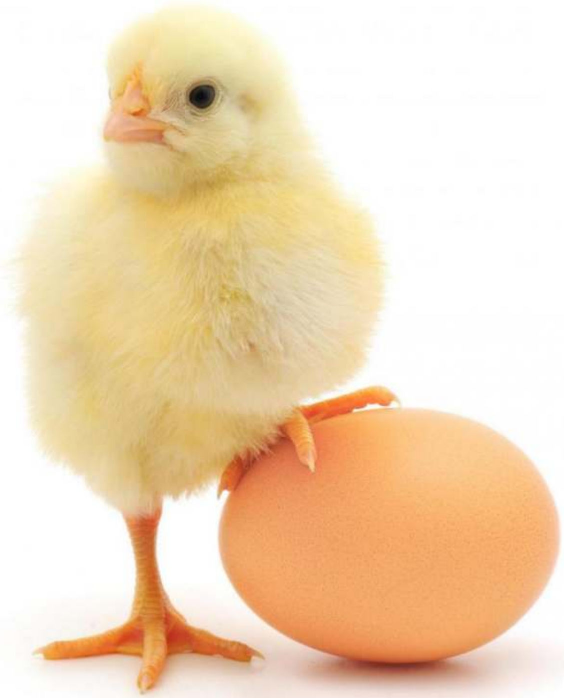
ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 8 (6): 536-544, 2009
ISSN 1682-8356

Genetic Improvement of Local Chickens by Crossing with the Label Rouge (T55XSA51): Growth Performances and Heterosis Effects

I.A.K. Youssao[1], M. Senou[2], M. Dahouda[2], M.T. Kpodékon[1], J. Djenontin[1], N-D. Idrissou[3], G.A. Bonou[1], U.P. Tougan[1], S. Ahounou[1], H.M. Assogba[1], E. Bankolé[1], X. Rognon[4] and M. Tixier-Boichard[4]
[1]Département de Production et Santé Animales, Université d'Abomey-Calavi, Ecole Polytechnique d'Abomey-Calavi, 01 BP 2009 Cotonou, Bénin
[2]Faculté des Sciences Agronomiques, Université d'Abomey, d'Abomey-Calavi, 01 BP 526 Cotonou, Bénin
[3]Centre de Gestion Durable des Ressources Animales et Végétales (CGDRAV_ONG), BP 1096, Parakou, Bénin
[4] INRA, Agro Paris Tech, UMR1313 "Génétique Animale et Biologie Intégrative", Centre de Recherches INRA, 78352 Jouy-en-Josas Cedex, France

Abstract: The study of Genetic improvement of local chickens by crossing with the Label Rouge was carried out on the Experimentation Farm of the Polytechnic School of Abomey-Calavi, from August 2007 to may 2008. At the hatching, 6 lots of chicks were made up: the lot MnFl, composed of 47 chicks resulting from the crossing between females Label Rouge and males of North ecotype; the lot MlFn, composed of 58 chicks resulting from the crossing between North females and males Label Rouge; the lot MsFl, composed of 36 chicks resulting from the crossing between Label Rouge females and males of the South ecotype; the lot of north local chickens composed of 112 chicks; the lot of South local chickens composed of 128 chicks and the lot of Label Rouge composed of 204 chicks. Label Rouge have an age-type weight significantly higher than the cross ones ($p<0.05$) and those have also an age-type weight more significant than the local chickens ($p<0.01$). The Label Rouge had more important feed intake than the local chickens and the crossbreeds had a feed intake intermediate between the ones of the Label Rouge and the local chickens. Among the chickens resulting from a parent of North ecotype, the hens resulting from a cock of North ecotype had a weak feed efficiency compared to the one resulting from females of North ecotype. The weight average heterosis was 21.95, 14.47 and 27.69%, respectively for the cross MnFl, MlFn and MsFl. Those of the female were 1.17; 23.2 and 4.62%, respectively for the cross MnFl, MlFn and MsFl. A negative heterosis effect was obtained for the feed intake and the feed efficiency of the various crossbreeds.

Key words: Chicken, weight, average daily gain, feed consumption, feed efficiency, heterosis

INTRODUCTION

Food safety is today the greatest challenge of the United State Organization for Food and Agriculture (FAO) and consists in obtaining and guaranteeing an increasing the quality and the quantity of food production for the population which increase year by year. In the field of animal production, poultry breeding represents one of the ways on which the countries of sub-Saharan Africa in general and the Benin in particular, were committed to increase their production of animal proteins. In Benin, in spite of the efforts provided by the government, the meat production in general and poultry meat in particular is under the needs expressed by the consumers and this deficit is made good by imports which increase year by year (FAOSTAT, 2008). For more durability and food safety in animal protein, the meat production must be directed towards the indigenous chicken populations which indeed account for 80% of the local production of chicken meat. In Benin, the indigenous chicken populations of the species *Gallus gallus* of the two great climatic areas (north and south) have a remarkable heterogeneity in phenotypical traits (live weight, body measurement, the feathers' colour, the feathers' structure, feather distribution, the feather drawing, the nature of feathering, the colouring of the legs and the eyes colour) (Youssao *et al*., 2007) and in polymorphism trait (Youssao *et al*., 2009a). The differences of colour come from major gene effect and cultural preferences of the breeder, but not by the climate.

A comparison for the growth performances and of the north ecotype chicken to those of the south ecotype was carried out in station in order to test if the difference of Live Weight between those two ecotypes chicken is due to the climate and/or to the breeding mode (Youssao *et al*., 2009b). In this study, the Label Rouge (T55 X SA51) were identified as control animal in the evaluation of the indigenous chicken populations of *Gallus gallus* species in the coastal countries of West Africa, in particular, in Benin, in Ivory coast and in Ghana within the frame of the Promoting Sustainable Development in Agricultural Research Systems Project (Youssao, 2006). It comes out from this study that the weight of Label Rouge (2539

g) was the double of these of indigenous chicken of north ecotype (1202 g) and 2.8 times these of indigenous chickens of south ecotype (880 g). The North local chickens have a live weight at slaughter higher than the ones of the South local chickens and were significantly weaker ($p<0.001$) than those of the Label Rouge (Youssao *et al.*, 2009b). In conclusion, the difference of weight performance comes from polygene effect, but not the climate too.

Taking into account of the differences on growth between the local chickens and the Label Rouge, it is necessary to improve the local chicken growth performance by crossing with Label Rouge. The aims of this study were to:

- Compare the growth performances, the feed intake and the feed efficiency of the various crossbreed to those of the parental ones.
- Evaluate the heterosis effect of the growth performances, the feed intake and the feed efficiency of the various crossbreeds.

MATERIALS AND METHODS

Study area: The study of Genetic improvement of local chickens by crossing with the Label Rouge was carried out on the Experimentation Farm of the Polytechnic School of Abomey-Calavi (EPAC), from August 2007 to May 2008. This Farm is located in the Department of the Atlantic and more precisely in the District of Abomey-Calavi. This district profits from the climatic conditions of subequatorial type, characterized by two rainy seasons: the large (from April to July) and the small (from September to November). These two seasons are intercalated by a dry seasons. Average pluviometry is close to 1200 mm per annum. The monthly average temperatures vary between 27 and 31°C and the relative humidity of the air fluctuates between 65% from January to March and 97% from June to July.

Animals and management: The reproductive animals used for this study are consisted of Label rouge chickens and local chickens of the North and South ecotypes. The Label Rouge chicken is a heavy stock with slow growth resulting from the final crossing between the T55 stocks and SA51 of the group SASSO. The local chickens of the North and South ecotypes came from the cores of reproducers of the Experimental Farm of the Animal Health and Production Department from of the Polytechnic School of Abomey-Calavi (EPAC). This study was carried out on a sample of reproducers divided into 7 lots:

- lot 1 is composed of 10 females Label Rouge and 4 males of North ecotype.
- lot 2 is composed of 10 females of North ecotype and 3 Label Rouge males.
- lot 3 is composed of 10 females Label Rouge and 4 males of the South ecotype.
- lot 4 is composed of 10 females of South ecotype and 4 males Label Rouge.
- lot 5 is composed of local chickens of the North ecotype.
- lot 6 is composed of local chickens of the South ecotype.
- lot 6 is composed of the Label Rouge.

These reproducers were old on average of 240±21 days and were in their third month of laying. The eggs obtained of the various lots were collected, counted, weighed and incubated per lot. At the hatching, 6 lots of chicks were made up:

- The lot MnFl is composed of 47 chicks resulting from the crossing between females Label Rouge and males of North ecotype.
- The lot MlFn is composed of 58 chicks resulting from the crossing between North females and males Label rouge.
- The lot MsFl is composed of 36 chicks resulting from the crossing between Label Rouge females and males of the South ecotype.
- The lot of north local chickens composed of 112 chicks.
- The lot of South local chickens composed of 128 chicks.
- The lot of Label Rouge composed of 204 chicks.

The coupling between the males Label Rouge and the females of South ecotype were stopped because the females of south ecotype are smaller in format than the males Label Rouge which regularly injury them during the coupling. Few fertile eggs were obtained, no eggs were incubated and in consequence, this lot weren't taken into account in the suite of the experiment.

All the animals were fed with the same diet. Three diets were used: starting (2880.53 EM Kcal/kg and 18.61% of crude protein), growth (2969.58 EM Kcal/kg and 17.8% crude protein) and laying (2800 EM Kcal/kg of feed and 20.14% of crude protein). The starter feed was used from the hatching to the age of 2 months and the growth feed from 2 month old to the point of laying (22 weeks). From the point of laying to the end of the experimentation, the laying feed was used. The animals were fed *ad libitum* throughout the study. The prevention against the disease of Newcasttle, Coccidiosis, avian infectious bronchitis, Gumboro, fowl pox and the Marek's disease was made. Monthly, a sampling of feces were analyzed in order to follow the effectiveness of the antiparasitic treatments made and to make sure that the coccidium and gastro-intestinal parasites do not influence the growth performances of the animals. The weight of each animal was taken at the hatching (P0), at

2 weeks old (P2), at 4 weeks old (P4) and then once per month and the Average Daily Gain (ADG) were calculated for each period. The daily feed intake were record and the feed efficiency (feed intake/weight gain) were calculated.

Statistical analysis: The data of weight were recorded at the hatching, to 2 and 4 weeks old and every 4 weeks, up to 24 weeks for each genetic type (Label Rouge, North ecotype Chicken, South ecotype chicken, the cross breed MnFl, MlFn and MsFl).

The Average Daily Gains (ADG) were calculated for the first two weeks after hatching, from the second to the fourth week and each four week. A linear model for fixed effect was adjusted with the data and includes the fixed effects of the genetic type and the sex. The interaction between sex and genetic type was significant and taken into account in the model.

Parameters of the growth curve were estimated with the Gompertz equation, according to Laird *et al.* (1965):

$$BW_t = BW_0\ e^{\,L(1-\exp(-Kt))/K}$$

Where BWt is the recorded body weight at age t, BW0 the estimated weight at hatching, L the initial specific growth rate (1/BWt)×(dBWt/dt) when t→0) and K the maturation rate or the exponential factor of decay of the specific growth rate. Age at inflexion (TI), at which the growth rate is maximum, was calculated as follows:

$$TI = \left(\frac{1}{K}\right)\ln\left|\frac{L}{K}\right|$$

These parameters were estimated by non-linear regression with the NLIN procedure of SAS (SAS Institute, 1989) taking into account all available weights from birth to slaughter. Observations were weighted by the ratio of the phenotypic variance of slaughter weight to the phenotypic variance of BWt, in order to take into account the increase of variance of body weight with age. Heterosis was estimated as:

$$Heterosis = \frac{F_1 - \dfrac{(Parent1 + Parent2)}{2}}{\dfrac{(Parent1 + Parent2)}{2}}$$

Where, F1 resulting from the crossing MnFl, MlFn or MsFl, the parents were male or female of Label Rouge and local chicken ecotype of the north or South area, according to the crossing.

For each parameter, the general linear models procedure was used for the variance analysis. The test of F was used to determine the significativity of each effect of the model. The means were compared two by two using the test of student. Comparisons between growth performances were also made between the three genetic types per sex.

RESULTS

Result of the variance analysis: The growth performances varied from one genetic type to another ($p<0.001$). Apart from the hatching weight and the average daily gain obtained after 16 weeks, the age-type weights and the average daily gain differ significantly according to the sex and the same tendency was observed for the interaction between genetic type and sex ($p<0.001$). For the weight, the coefficient of determination of the model of analysis was equal or higher than 0.80 and the coefficients of variation varied from 11.12-21.25%. For the average daily gains, the model expressed less than 50% of variations after the age of 12 weeks with coefficients of variation more than 48%. Table 1 presents the genetic type effects, the sex effect and their interaction on the weight performances.

Effect of the genetic type on the weight: At the hatching, the Label Rouge chicks (43.03 g) and the cross MsFl (38.23 g) have a weight significantly more important ($p<0.001$) than those of local chickens of the North ecotypes (26.72 g) and South ecotype (26.25 g) and those resulting from the crossing MlFn (26.18 g). Those of the MnFl crossing had an intermediate weight (36.17 g) which differs significantly from the others. Throughout the growth, the Label Rouge have an age-type weight significantly higher than the cross ones ($p<0.05$) and those have also an age-type weight more significant than the local chickens ($p<0.01$).

In the group of the cross ones, the weights at 4 weeks were similar for the three genetic types and various difference were recorded for the weights at 2 and 8 weeks. Beyond 8 weeks, cross MnFl and cross MsFl have identical growth performances and significantly higher than those of cross MlLn.

As for local chickens, the difference in weight was not significant from the hatching to the age of 8 weeks age. From the 12th week to the end of the experimentation, the local chickens of North ecotype have age-type weights significantly higher than South ecotype chickens ($p<0.01$).

The Label have an Average Daily Gain (ADG) significantly higher ($p< 0.001$) than that of local chickens (North and South) and the crossbreed from the birth until the 8^{th} week of age. From the 8^{th} to the 12^{th} week, the Labels do not present a significant difference with the average daily gain of cross of the genetic types MnFl and MsFl. The cross of the genetic type MlFn (14.56 g) had intermediate average daily gain and differ from the others. Apart from 12^{th} to the 16th week, where the cross ones have average daily gain more important than the Label and the local (north and south), their average daily

Table 1: Significance of the effects of the genetic type, the sex and their interactions on the weight performances of the chickens

Variables	Genetic Type	Sex	Interaction	R^2	CV (%)	RSD
W0 (g)	***	NS	NS	0.81	11.12	3.74
W2 (g)	***	***	*	0.82	21.25	20.56
W4 (g)	***	***	***	0.87	21.01	48.17
W8 (g)	***	***	***	0.91	18.77	122.6
W12 (g)	***	***	***	0.92	15.75	155.47
W16 (g)	***	***	***	0.89	16.96	206.48
W20 (g)	***	***	***	0.83	18.43	271.18
W24 (g)	***	***	***	0.8	18.19	310.24
ADG_{2-0} (g/d)	***	***	***	0.77	32.28	1.45
ADG_{4-2} (g/d)	***	***	**	0.78	34.1	3.23
ADG_{8-4} (g/d)	***	***	***	0.83	29.47	4.31
ADG_{12-8} (g/d)	***	***	***	0.58	41.35	5.15
ADG_{16-12} (g/d)	***	***	***	0.47	48.88	4.86
ADG_{20-16} (g/d)	***	NS	NS	0.11	69.59	5.83
ADG_{24-20} (g/d)	***	NS	NS	0.28	70.22	5.84
K (1/d)	***	*	*	0.23	20.46	0.005
L (1/d)	***	*	*	0.35	20.79	0.021
Ti (d)	***	**	**	0.28	24.44	13.99

Wi: weight at i week; ADG_{i-j}: average daily gain from i to j week ; NS: p>0.05; *: p< 0.05; ***: p < 0.001; R^2: Cœfficient of determination; RSD: Residual standard deviation; CV: Coefficient of variation

Table 2: Least square means and standard errors of the weight and the average daily gain per genetic type

	Label Rouge		North		South		MnFl		MlFn		MsFl	
Variables	Means	ES	Means	ES	Means	ES	Means	ES	Means	ES	Means	ES
W0 (g)	43.03^a	0.26	26.72^c	0.36	26.25^c	0.33	36.17^b	0.55	26.18^c	0.49	38.23^a	0.65
W2 (g)	147.16^a	1.46	50.26^e	2.01	45.93^e	1.82	114.85^c	2.99	95.75^d	2.70	124.95^b	3.57
W4 (g)	387.84^a	3.41	105.84^c	4.70	95.95^c	4.27	231.56^b	7.03	218.62^b	6.33	234.94^b	8.36
W8 (g)	1099.59^a	8.69	229.06^d	13.24	205.26^d	12.73	651.23^b	17.89	568.45^c	16.11	594.99^c	21.27
W12 (g)	1548.33^a	11.02	418.82^d	16.55	323.34^e	15.87	1122.17^b	22.68	969.08^c	20.43	1066.33^b	26.97
W16 (g)	1747.75^a	14.64	556.84^d	23.46	436.66^e	20.26	1564.61^b	30.12	1360.37^c	27.13	1497.71^b	35.82
W20 (g)	2009.35^a	19.22	839.48^d	33.41	594.09^e	28.20	1748.79^b	39.56	1539.2^c	35.97	1658.19^b	47.05
W24 (g)	2290.04^a	22.70	985.59^c	46.61	711.11^d	41.15	1796.86^b	45.26	1587.59^c	41.15	1694.6^b	53.82
ADG_{2-0} (g/d)	7.44^a	0.10	1.68^d	0.14	1.41^d	0.13	5.62^b	0.21	4.97^c	0.19	6.19^b	0.25
ADG_{4-2} (g/d)	17.29^a	0.23	3.97^c	0.32	3.57^c	0.28	8.34^b	0.47	8.78^b	0.42	7.86^b	0.56
ADG_{8-4}(g/d)	25.42^a	0.30	4.34^d	0.46	3.8^d	0.45	14.99^b	0.63	12.49^c	0.57	12.86^c	0.75
ADG_{12-8} (g/d)	16.31^a	0.37	6.55^c	0.56	4.23^d	0.57	16.82^a	0.75	14.56^b	0.68	16.83^a	0.89
ADG_{16-12} (g/d)	9.87^b	0.38	5.95^c	0.61	4.62^d	0.54	15.8^a	0.71	13.97^a	0.63	15.41^a	0.84
ADG_{20-16} (g/d)	10.48^a	0.43	7.67^c	0.82	5.63^d	0.65	8.32^b	0.91	6.82^b	0.80	6.69^{ab}	1.06
ADG_{24-20} (g/d)	11.67^a	0.44	5.8^b	0.99	5.54^b	0.82	3.02^c	1.35	5.32^b	0.92	2.94^c	1.36
K(1/d)	0.03^a	0.001	0.018^b	0.001	0.021^b	0.002	0.028^a	0.002	0.029^a	0.002	0.028^a	0.001
L(1/d)	0.10a	0.001	0.093^a	0.004	0.221^b	0.003	0.267^c	0.007	0.353^d	0.03	0.296^e	0.01
Ti (d)	54.46a	0.99	94.42^b	3.39	112.43^c	4.04	80.51^d	3.22	86.22^e	3.01	84.12^{ed}	2.99

ES: standard error; Wi:weight at I week; ADG_{i-j}: average daily gain from i to j week; MnFl: north male and label female; MlFn: label male and north female; MsFl: south male and label female; SE: standard error; the means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

gains were significantly lower than those of the Label. From the 8th to the 24th week, the North local chickens have a growth more important than the South ecotypes animals (p<0.01) and have an average daily gain superior to a significant degree (p<0.001) to those of the crossbreed. In general, the monthly average daily gain was more significant in the Label rouge group than in the crossbreed group and the weakest gains were obtained in the local chickens group. The detail on the weight evolution and the average daily gain is given in the Table 2.

Weight performances of chickens per sex: By considering the whole of the animals, the males (32.49 g) and the females (33.04 g) have similar weights at the hatching. Throughout the experimentation, the males have an age-type weight significantly higher than the females. The weight of the males was 1667 g against 1305g for the females. Table 3 presents the weight performances per sex for the whole of the animals.

Interaction between genetic type and sex: The Table 3 presents the age-type weights and the average daily gain per genetic type and per sex. At the hatching, the weight of the males was not different from that of the females for each genetic type. During the phase of growth, distinctive characteristics were observed per genetic type.

Table 3: Least square means and standard errors of the weight and the average daily gain per genetic type and per sex

	Label		North		South	
Variable	Male	Female	Male	Female	Male	Female
W0 (g)	42.76^{a}	43.29^{a}	26.83^{a}	26.61^{a}	26.27^{a}	26.22^{a}
W2 (g)	147.3^{a}	147.03^{a}	50.68^{a}	49.84^{a}	46.96^{a}	44.9^{a}
W4 (g)	387.81^{a}	387.87^{a}	109.71^{a}	101.96^{a}	103.08^{a}	88.83^{a}
W8 (g)	1126.12^{a}	1073.05^{b}	238.09^{a}	220.03^{a}	217.04^{a}	193.47^{a}
W12 (g)	1691.22^{a}	1405.44^{b}	444.3^{a}	393.33^{a}	340.96^{a}	305.71^{a}
W16 (g)	1802.14^{a}	1693.37^{b}	617.97^{a}	495.71^{b}	441.17^{a}	432.15^{a}
W20 (g)	2052.65^{a}	1966.04^{b}	949.46^{a}	729.5^{b}	608.66^{a}	579.53^{a}
W24 (g)	2386.89^{a}	2193.2^{b}	1089.37^{a}	881.6^{b}	745^{a}	677.22^{a}
ADG_{2-0} (g/d)	7.47^{a}	7.41^{a}	1.7^{a}	1.66^{a}	1.48^{a}	1.33^{a}
ADG_{4-2} (g/d)	17.18^{a}	17.4^{a}	4.22^{a}	3.72^{a}	4.01^{a}	3.14^{a}
ADG_{8-4} (g/d)	26.37^{a}	24.47$_{b}$	4.54^{a}	4.15^{a}	4^{a}	3.6^{a}
ADG_{12-8} (g/d)	20.18^{a}	12.43^{b}	6.97^{a}	6.12^{a}	4.6^{a}	3.86^{a}
ADG_{16-12} (g/d)	8.47^{a}	11.28^{b}	6.53^{a}	5.37^{a}	4.77^{a}	4.48^{a}
ADG_{20-16} (g/d)	10.5^{a}	10.46^{a}	8.84^{a}	6.51^{a}	5.5^{a}	5.76^{a}
ADG_{24-20} (g/d)	12.98^{a}	10.36^{b}	6.35^{a}	5.25^{a}	5.68^{a}	5.39^{a}
K (1/d)	0.03^{a}	0.025^{b}	0.017^{c}	0.019^{cd}	0.021^{d}	0.021^{d}
L (1/d)	0.11^{a}	0.099^{a}	0.093^{b}	0.092^{b}	0.222^{c}	0.220^{c}
Ti (d)	54.25^{a}	54.65^{a}	94.22^{b}	94.63^{b}	108.43^{c}	116.44^{c}

	MnFl		MlFn		MsFl		
Variable	Male	Female	Male	Female	Male	Female	RSD*
W0 (g)	36.35^{a}	36^{a}	24.96^{a}	27.4^{b}	37.77^{a}	38.7^{a}	3.74
W2 (g)	117.87^{a}	111.83^{a}	106.07^{a}	85.43^{b}	133.08^{a}	116.83^{b}	20.56
W4 (g)	245.87^{a}	217.25^{b}	252.64^{a}	184.6^{b}	244.23^{a}	225.65^{a}	48.17
W8 (g)	713.91^{a}	588.54^{b}	688.39^{a}	448.5^{b}	648.46^{a}	541.52^{b}	122.6
W12 (g)	1274.35^{a}	970.01^{b}	1227.5^{a}	710.67^{b}	1227^{a}	905.65^{b}	155.47
W16 (g)	1801.3^{a}	1327.92^{b}	1756.07^{a}	964.67^{b}	1738.46^{a}	1256.96^{b}	206.48
W20 (g)	1931.74^{a}	1565.83^{b}	1930.74^{a}	1147.67^{b}	1887.69^{a}	1428.69^{b}	271.18
W24 (g)	1949.13^{a}	1464.58^{b}	1982.85^{a}	1192.33^{b}	1846.15^{a}	1423.04^{b}	310.24
ADG_{2-0} (g/d)	5.82^{a}	5.42^{a}	5.79^{a}	4.14^{b}	6.81^{a}	5.98^{a}	1.45
ADG_{4-2} (g/d)	9.14^{a}	7.53^{a}	10.47^{a}	7.08^{b}	7.94^{a}	7.77^{a}	3.23
ADG_{8-4} (g/d)	16.71^{a}	13.26^{b}	15.56^{a}	9.42^{b}	14.44^{a}	11.28^{b}	4.31
ADG_{12-8} (g/d	20.01^{a}	13.62^{b}	19.25^{a}	9.87^{b}	20.66^{a}	13^{b}	5.15
ADG_{16-12} (g/d)	18.82^{a}	12.78^{b}	18.88^{a}	9.07^{b}	18.27^{a}	12.55^{b}	4.86
ADG_{20-16} (g/d)	7.16^{a}	9.48^{a}	6.56^{a}	7.08^{a}	6.01^{a}	7.37^{a}	5.83
ADG_{24-20} (g/d)	2.83^{a}	3.21^{a}	6.81^{a}	3.82^{a}	2.5^{a}	3.38^{a}	5.84
K (1/d)	0.024^{b}	0.029^{a}	0.025^{b}	0.032^{d}	0.023^{b}	0.032^{d}	0.005
L (1/d)	0.264^{d}	0.272^{d}	0.333^{e}	0.374^{f}	0.291^{b}	0.298^{b}	0.021
Ti (d)	77.11^{d}	83.61^{d}	83.72^{e}	86.22^{e}	82.21^{e}	87. 01^{e}	13.99

Wi: weight at i week; ADG_{i-j}: average daily gain from i to j week; MnFl: north male and label female; MlFn: label male and north female; MsFl: south male and label female; SE: standard error; the means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

In the group of Label Rouge chickens, the age-type weight of the males is identical to that of the females during the first 4 weeks. From the 8th week, the males have a weight at standard age significantly higher than the females. The weight at the hatching of the males and that of the females were respectively 43.76 and 43.29g. The variation of weight between the males and the females were 193.6 g. At last, the males have average daily gain higher than those of the females in the majority of the cases.

In local chickens of North ecotype, the males were significantly heavier than the females from the 16th week to the end of the experimentation, on the other hand no significant difference was observed at the South ecotypes although the males were heavier than the females throughout the growth. The weight of the males of North ecotype was 26.83 g at the hatching and 1089 g at 24 weeks; that of the females of the North ecotype were respectively 26.61 g and 881 g. The males of the North and South ecotypes have average daily gain higher than those of the females without however presenting significant difference ($p>0.05$).

At the cross ones, the sexual dimorphism was observed on the weight of the MlFn chicks at the hatching. This difference was observed only two weeks after the hatching at cross MsFl and at 4 weeks at cross MnFl ($p<0.05$). Once these differences observed the variation of weight between the males and the female increases according to the age. For the average daily gains, the difference between the males and the females cross

MnFl and MsFl were only significant from the 4th to the 16th week (p<0.05). On the other hand, at MlFn, the males have average daily gains significantly more significant than the females from the hatching to the 16th week age.

Heterosis effect of growth performances: The heterosis effect of the various weight and average daily gain are given per crossbreed in Table 4. It comes out that the majority of the heterosis effects were highly significant.

For the cross MnFl, apart from the negative heterosis effect observed in the males weight at 4 weeks, the heterosis were positive for the other age-type weights and varied from 4-56%. Some negative heterosis was observed for the average daily gains, in particular from 2 -4 weeks and 16-24 weeks. The average heterosis was 21.95% for the weight and 21.89% for the average daily gains. In the females, the heterosis effect was observed little and was only on average 1.17% for the weight and 0.09% for the average daily gains.

For the cross MsFl, in the male, the heterosis effect of the weight was near to 0 between the 4th and the 8th week. It varied from 8.6-63% for the various age-type weights. Some negative heterosis effects were obtained at the beginning and the end of the growth. On average the heterosis effect was 27.69% for the weights and 7.74 % for the weight gain. The heterosis effect was observed less in the females compared to the males resulting from the MsFl crossing, with on averages of 4.62% and 4.27%, respectively for the weights and the average daily gain.

At last, in the males MlFn, apart from the weight at the hatching where the heterosis is negative, the heterosis effects varied from 2-53% with an average of 14.47%. Just like cross MsFl, MlFn presented negative heterosis towards the end of the growth; however the average heterosis of the average daily gain was 28.58%. On the other hand, in the females MlFn, negative heterosis were obtained for the age-type weights and the average daily gains with respective values of -23 and -21%.

Feed intake and the feed efficiency: The feed intake and the feed efficiency were given per lot (Table 5) and for each lot, the feed intake and the feed efficiency were respectively presented per weighting period in the Tables 6 and 7. The Label Rouge had more important feed intake than the local chickens and the crossbreeds had a feed intake intermediate between the ones of the Label Rouge and the local chickens. About the lots, the chickens containing the blood of North ecotype had the weakest feed efficiencies compared to the chickens containing the South ecotype blood (p<0.05). Among the chickens resulting from a parent of North ecotype, the hens resulting from a cock of North ecotype had a weak feed efficiency compared to the one resulting from females of North ecotype. The feed intake and the feed efficiency increase according to the age (Table 6 and 7) whereas the average daily gain increases from the hatching to the inflexion age before decreasing.

A negative heterosis effect was obtained for the feed intake and the feed efficiency of the various crossbreeds. For the feed intake, the heterosis effect was significant for the crossbreed MnFl (p<0.05) and highly significant for the crossbreed MlFn (p<0.05). For the feed efficiency, the heterosis effect was highly significant for the three types of cross. The value of the heterosis effects are given in the Table 8.

DISCUSSION

The results obtained in the present study revealed considerable and significant differences between the locale chicken of the North, locale chicken of the South, Label Rouge and their crossbred. The better productive performance of Label Rouge, as compared to Locale Chicken, was expected and was similar to this of Fotsa (2008). This is the result of genetic improvement practices being carried out on Label Rouge. As a consequence, indigenous chickens are less efficient for nutrient retention than Label Rouge Chicken. The intermediate weight performances of the cross chicks observed during our study go in the same order of idea as Pedersen (2002) which according to the study of the crossing of a cock Cobb #500 (Cobb breeding compagny Ltd., 2002) and local hens of Zimbabwe, showed that at 8 weeks, the chickens of stock Cobb #500 weighed 3308 g and the local chickens 688 g (Pederson *et al.*, 2002) whereas the average weight of cross was of 1400 g. The same tendency was observed by Gnakari *et al.* (2007) which after having observed that the broiler chicks grow more quickly than African chicks, and at the end of 8 week of breeding, the broiler has an average live weight of 1658±7 g against 700±6 g for african chicken, noticed that the F1 chicks resulting from their crossing have on the other hand a growth slightly higher than that of African chicks, with a final average body weight of 880±5g. Moreover our study which showed that crossed had a growth more raised than that of the local chicken, goes in the same direction as Leroy (2003) who noted that the Ardennaise race in crossing presented a growth more interesting than that of the inhabitants of the Ardennes in pure race. The average weights at the hatching and twelve weeks are respectively 41.48 g and 1831.96 g at the cross ones, while they are of 28.69 g and 1.053.23 g among inhabitants of the Ardennes in pure race.

At the cross ones, the weights at 4 weeks were identical for the three genetic types and of the various variations were recorded for the weights with 2 and 8 weeks. Beyond 8 weeks, MnFl and MsFl have identical weight performances and significantly higher than those of MlLn. This difference observed between the various

Table 4: Heterosis effect of cross breed

	MnFl		MsFl		MlFn	
Variables	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
W0 (g)	3.68^{NS}	2.68^{NS}	8.60**	11.27***	-28.04***	-21.00***
W2 (g)	19.24***	13.13**	37.20***	20.45***	7.61^{NS}	-13.33**
W4 (g)	-1.17^{NS}	-12.68*	-0.51^{NS}	- 8.08^{NS}	3.17^{NS}	-24.62***
W8 (g)	8.90^{NS}	-10.22*	0.53^{NS}	-16.05***	2.28^{NS}	-33.37***
W12 (g)	37.79***	4.88*	40.52***	3.72^{NS}	17.77***	-31.82***
W16 (g)	55.87***	14.90***	62.89***	17.77***	52.84***	-16.04**
W20 (g)	32.52***	7.41***	46.63***	10.98**	38.79***	-17.50***
W24 (g)	18.76*	-10.77^{NS}	25.67**	-3.14^{NS}	21.33**	-27.04***
ADG$_{2-0}$ (g/d)	27.77***	18.99*	53.20***	34.53***	26.83***	-9.31^{NS}
ADG$_{4-2}$ (g/d)	-15.45^{NS}	-30.34***	-25.83*	-27.42***	0.19^{NS}	-32.25***
ADG$_{8-4}$ (g/d)	15.20^{NS}	-8.58^{NS}	1.44^{NS}	-20.76**	1.97^{NS}	-38.27***
ADG$_{12-8}$ (g/d)	106.29***	40.41***	142.63***	52.67**	46.39***	-24.94***
ADG$_{16-12}$ (g/d)	111.3***	43.51**	127.66***	56.39***	172.83***	31.07^{NS}
ADG$_{20-16}$ (g/d)	-25.80^{NS}	-1.76^{NS}	-24.69^{NS}	- 7.64**	-22.87*	-16.75^{NS}
ADG$_{24-20}$ (g/d)	- 66.13***	-61.58*	-68.83**	-57.86**	-25.29^{NS}	-58.09**

Wi: weight at i week; ADG$_{i-j}$: average daily gain from i to j week; MnFl: north male and label female; MlFn: label male and north female; MsFl: south male and label female; ***: p<0,001; **: p<0,001; NS: p>0.05

Table 5: Feed intake and feed efficiency of indigenous chicken, Label Rouge and their crossbreed

	Feed intake (g)		ADG (g/d)		Feed efficiency	
Animal	Means	ES	Means	ES	Means	ES
Label Rouge	70.91^{a}	0.9	12.83^{a}	0.05	6.82^{a}	0.09
MlFn	44.69^{c}	0.67	10.20^{c}	0.04	4.55^{d}	0.07
MnFl	54.79^{b}	0.68	11.63^{b}	0.04	4.84^{c}	0.07
MsFl	55.24^{b}	0.68	10.58^{c}	0.04	5.56^{b}	0.07
North ecotype	34.68^{e}	0.91	8.63^{d}	0.05	4.01^{e}	0.09
South ecotype	38.72^{d}	0.91	6.87^{c}	0.05	5.51^{b}	0.09

SE: standard error; the means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

Table 6: Feed intake per age and genetic types

Period	Label		MlFn		MnFl		MsFl		Nord		Sud	
(week)	Mean	SE	Means	SE	Means	SE	Means	SE	Means	SE	Means	SE
0-2	25.13^{a}	2.71	7.85^{f}	1.95	13.51^{c}	1.98	14.68^{b}	2.02	8.67^{e}	2.8	10.03^{d}	2.8
2-4	56.87^{a}	2.71	22.46^{d}	1.92	44.72^{b}	1.92	29.65^{c}	1.92	11.87^{f}	2.71	14.29^{e}	2.71
4-8	73.18^{a}	1.91	47.33^{c}	1.33	47.77^{b}	1.33	50.58^{b}	1.33	23.12^{e}	1.88	25.69^{d}	1.88
8-12	80.04^{a}	1.91	50.97^{d}	1.35	66.55^{b}	1.35	61.51^{c}	1.35	43.58	1.92	44.51^{e}	1.92
12-16	89.78^{a}	1.91	62.67^{c}	1.33	81.16^{b}	1.33	82.06^{b}	1.33	60.62^{c}	1.88	60.24^{c}	1.88
16-20	100.48^{a}	1.91	76.84^{c}	1.88	75.02^{c}	1.88	92.94^{b}	1.88	60.18^{d}	1.91	77.5^{c}	1.92

SE: standard error; the means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

genetic types is comparable with the study carried out by Pedersen (2002) on the cross from 31 days to 52 days and Segura-Correa *et al.* (2004) on the study about productive performance of Creole Chicken and their cross raised under semi-intensive management condition in Yucatan (Mexique).

In local chickens, the difference in weight was not significant from the hatching to the age of 8 weeks. From the 12th week to the end of the experimentation, the local chickens of North ecotype have age-type weights significantly higher than chickens of the South (p<0.01). This observation goes in the same direction as Youssao *et al.* (2007) which reported that the weight of chickens of North (1197 g) is higher (p<0.001) than that of the South (946 g) at the adulthood. Mourad *et al.* (1997) obtained a weight of 28.82 g in local chicks paid at the hatching on the plate of Sankaran Faranah in Guinea.

In general, the monthly average daily gains were more significant at the Label Rouge than at the crossbreed and the weakest gains were obtained at the local chickens. These improvements could be attributed partially to heterosis effect caused by gene frequencies between the population involved (Falconer and Mackay, 1996).

Throughout the experimentation, the males (32.49 g with 1667 g) have an age-type weight significantly higher than

Table 7: Feed efficiency according to the age and the genetic types

Period (week)	Label Rouge		MIFn		MnFI		MsFI		Nord		Sud	
	Means	SE	Means	SE	Means	SE	Means	SE	Means	SE	Means	SE
0-2	3.62[a]	0.27	1.57[c]	0.19	2.41[b]	0.19	2.44[b]	0.2	2.49[b]	0.28	3.79[a]	0.28
2-4	3.54[b]	0.27	2.57[c]	0.19	5.38[a]	0.19	3.78[b]	0.19	1.47[d]	0.27	3.52[b]	0.27
4-8	3.08[d]	0.19	3.82[b]	0.13	3.19[c]	0.13	4.07[a]	0.13	2.34[f]	0.18	2.96[e]	0.18
8-12	5.73[a]	0.19	3.52[d]	0.14	3.97[b]	0.14	3.90[b]	0.14	3.86[bc]	0.19	4.01[b]	0.19
12-16	13.42[a]	0.19	4.54[f]	0.13	5.16[e]	0.13	5.61[d]	0.13	6.93[c]	0.18	8.02[b]	0.18
16-20	11.55[b]	0.19	11.25[bc]	0.18	8.93[d]	0.18	13.54[a]	0.19	6.91[e]	0.19	10.75[c]	0.19

The means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

Table 8: Heterosis effect of feed intake and feed efficiency of the various crossings between Label Rouge and Benin Indigenous chicken

Period (week)	Feed intake (%)			Feed eficiency		
	MIFn	MnFI	MsFI	MIFn	MnFI	MsFI
0-2	-53.55***	-20.06**	-16.50*	-48.61***	-21.11*	-34.14***
2-4	-34.65**	-28.08*	-16.67NS	2.59NS	114.77***	7.08NS
4-8	-1.70NS	-0.79NS	2.32NS	40.96***	17.71***	34.77***
8-12	-17.54NS	7.67NS	-1.23NS	-26.59***	-17.21***	-19.92***
12-16	-16.66***	7.93**	9.40***	-55.38***	-49.29***	-47.67***
16-20	-17.34***	7.73**	2.44NS	21.89***	-18.57***	21.43***
Means	-21.41***	-4.66*	-3.04NS	-10.86***	6.94***	-6.41***

MnFI: north male and label female; MIFn: label male and north female; MsFI: south male and label female; ***: p<0,001; **: p<0,001; NS: p>0.05

the females (33.04-1305 g). The same tendency was observed by Pedersen (2002) on the level of cross (cock Cobb #500 X local hen) where the weight of the males (2364 g) is higher than that of the females (1889 g) at 73 days old. In our study, the males have average gains higher than those of the females in the majority of the cases. This is similar to the study of the crossing Cobb #500 X local carried out by Pedersen *et al.* (2002) in which the males of the ecotype Cobb #500 and the females had respectively at 56 days, the average daily gains of 21.2 g/j and 16.8 g/j.

In this study, the average heterosis effects were high (up to 20%) because the parent differed greatly in body conformation (Table 2). Those results are similar to the ones reported in the literature (Emmerson *et al.*, 1991; Ye *et al.*, 1997; Nestor and Anderson, 1998; Nestor *et al.*, 2001; Ndegwa *et al.*, 2001). The heterosis effect varies according to the sex. Heterosis was an important source of variation in BW for male from both crosses obtained from two commercial lines (A and B) who were reciprocally crossed with the F line and the percentage heterosis at the various age ranged from 3.1-7.5 (Nestor *et al.*, 2001). For female, heterosis (range 2.6-4.9%) was only significant at younger age (8 weeks) (Nestor *et al.*, 2001). Similar results were observed in this study.

The Label Rouge had more important feed intake than the local chickens and the crossbreeds had a feed intake intermediate between the ones of the Label Rouge and the local chickens. The same tendency were reported by Segura-Correa *et al.* (2004) who observe that feed consumption was lower for the Creole chicks at all ages.

As for the result of this study, the feed intake and the feed efficiency increase according to the age whereas the average daily gain increase from the hatching to the inflexion age before decreasing (Segura-Correa *et al.*, 2004). The feed consumption and the feed efficiency of indigenous chicken was low than those of commercial lines (Rodriguez *et al.*, 1996; Prado-Gonzalez *et al.*, 2003). In this study, the Label Rouge has the higher feed efficiency because the feed efficiency were calculated from haching to 24 months. Beyond 12 weeks, it is not economically profitable to rise in tropical zone. Economically, the 10th week is advised because the feed conversion at the 12th week is 7.7 against 4.29 for the 10th week and for a live weight of 1691 g. In France, the slaughter age was also fixed at 81 days (Sante *et al.*, 2001). At last, heterosis of feed efficiency was negative and the same tendency was observed by Segura-Correa *et al.* (2004).

Conclusion: The study of the performances of chickens resulting from the crossing Label Rouge and the local chickens (T55 X SA51) were carried out in sub-wet tropical area of Benin. It comes out that the weight performances of the Label Rouge are better than those of the cross and the cross have weight performances better than those of local chickens of the North and South ecotypes. The monthly average daily gains were more significant at the Label Rouge than at the cross ones and the weakest gains were obtained at the local chickens. The Label Rouge had more important feed intake than the local chickens and the crossbreeds had a feed intake intermediate between the ones of the Label Rouge and the local chickens. A negative heterosis effect was obtained for the feed intake and the feed efficiency of the various crossbreeds. For the whole of the animals, the males and the females had a similar weight at the hatching and throughout the experimentation the males had an age-type weight significantly higher than the females. Positive heterosis effects were observed in the males and females of the cross group, whose father is of local breed, local and in the cross males coming from the Label fathers. In the females cross whose fathers are Label, a negative heterosis effect was obtained because of nanism gene which is expressed in females and recessive in the males.

ACKNOWLEDGEMENT

The authors think the Promoting Sustainable Development in Agricultural Research Systems Project (DURAS) for his financial contribution.

REFERENCES

Emmerson, D.A., N.B. Anthony and K.E Nestor, 1991. Genetics of growth and reproduction in the turkey. 11. Evidence of nonadditive genetic variation. Poult. Sci. 70: 1084-1091.

Falconer, D.S. and T. Mackay, 1996. Introduction to Quantative Genetics, 4th Edn (London and New York, Longman).

FAOSTAT, 2008. Banques de données, FAOSTAT: Agriculture. Consulté le 27 février 2008 à l'adresse: http://apps.fao.org/page/collections?subset=agriculture&language=FR.

Fotsa, J-C., 2008. Caractérisation des populations de poules locales (*gallus gallus*) au Cameroun. Thèse de doctorat, Agroparistech, Paris, pp: 301.

Gnakari, A., M. Beugré Grah and E. Agbo Adouko, 2007. Croissance corporelle et qualité organoleptique de la viande du poulet de chair et du poulet africain et leurs croisements en Côte d'Ivoire. pp: 8.

Laird, A.K., S.A. Tyler and A.D. Barton, 1965. Dynamics of normal growth. Growth, 29: 233-248.

Leroy, 2003. Le Poulet d'Ardenne. Département des Productions Animales. Faculté de Médecine Vétérinaire Université de Liège, pp: 13.

Mourad, M., A.S. Bah and G. Gbanamou, 1997. Evaluation de la productivité et de la mortalité de la poule locale sur le plateau du Sankara, Faranah, Guinée, en 1993-1994. Revue Elevage et Médecine Vétérinaire des Pays Tropicaux, 50: 343-349.

Ndegwa, J., R. Mead, P. Norrish, C. Kimani and A. Wachira, 2001. The growth performance of indigenous Kenyan chickens fed diets containing different levels of protein during rearing. Tropical-Animal-Health-Production, 33: 441-48.

Nestor, K.E., J.W. Anderson and S.G. Velleman, 2001. Genetic Variation in Pure Lines and Cross of Large-Bodied Turkey Lines. 1. Body Weight, Walking Ability, and Body Measurements of Live Birds. Poult. Sci., 80: 1087-1092.

Nestor, K.E. and J.W. Anderson, 1998. Effect of crossing a line selected for increased shank width and two commercial sire lines on performance and walking ability. Poult. Sci., 77: 1601-1607.

Pedersen, C.V., 2002. Traditional chicken in a communal area of Zimbabwe. A baseline survey on production and management. In: Production of Semi-Scavenging Chickens in Zimbabwe. PhD. Thesis, University of Copenhagen, Denmark, 21-37.

Prado-Gonzalez, E.A., L. Ramirez-Avila and J.C. Segura-Correa, 2003. Genetic parameters for body weights of Creole chickens from Southeastern Mexico using an animal model. Livest. Res. Rural Dev., 15 (1).

Rodriguez, B.J.C., G.E. Allaway, G.J. Wassink, C.J.C. Segura and O.T. Rivera, 1996. Estudo de la Avicultura de traspatio en el municipio de Dzununcan, Yucatan. Vet. México, 27:215-219.

Sante, V., X. Fernandez, G. Monin and J-P Renou, 2001 Méthode de mesure de la qualité des viandes de volaille. INRA. Prod. Anim., 14: 247-54.

SAS, 1989. SAS/STAT User's guide, vers. 6, 4th Ed. Cary, NC, USA, SAS Inst, 1989, pp: 120.

Segura-Correa, J.C., L. Sarmiento-Franco, J.G. Magaa-Monforte and R. Santos-Ricalde, 2004. Productive performance of Creole chickens and their cross raised under semi-intensive management conditions in Yucatan, Mexico. Br. Poult. Sci., 45: 342-345.

Ye, X., W. Anderson, D.O. Noble, J. Zhu and K.E. Nestor, 1997. Influence of crossing a line selected for increased shank width and a commercial sire line on performance and walking ability of turkeys. Poult. Sci., 76: 1327-1331.

Youssao, A.K.I., X. Rognon, V. Yapi-Gnaore, T.M. Kpodekon, N-D. Idrissou, B. Kayang, S.A. Houinsou, S. Ahounou and M. Tixier-Boichard, 2009a. Growth performances and laying abilities of the indigenous chickens of Benin and Label Rouge (T55×SA51). 5th World Poultry Conference, 10 au 13 mars 2009a, Taba, Egypt.

Youssao, A.K.I., X. Rognon, V. Yapi-Gnaore, T.M. Kpodekon, N-D Idrissou, B. Kayang, P.U. Tougan, S. Ahounou and M. Tixier-Boichard, 2009b. Molecular polymorphism of indigenous poultry population of the species *Gallus gallus* of North and South ecotypes of Benin. 5th World Poultry Conference, 10 au 13 mars 2009b, Taba, Egypt.

Youssao, A.K.I., 2006. Caractérisation morphologique, génétique et zootechnique des populations locales de volailles de l'espèce gallus gallus dans la zone côtière de l'Afrique de l'Ouest. http://www.duras-project.net/index.php?id=17&lang=eng

Youssao, A.K.I., R. Adehan, M.T. Kpodekon, G. Bonou, J. Dougnon and B. Koutinhouin, 2007. Diversité génétique des populations locales de volailles de l'espèce *Gallus gallus* au Sud et au Nord du Bénin. 1er Colloque de l'UAC des Sciences, Cultures et Technologies, du 25 au 29 juin 2007 à Abomey-Calavi, 230-234.