Utilization of Genotype x Season Interaction in the Production of Layer Chickens in the Hot-humid Tropical Environment

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Abstract

Genotype x Environment interaction described as change in the relative performance of a genotype in two or more environments is a factor in the breeding of chickens in the tropics. Cock weight, hen weight, Hen-house production, egg weight, fertility of eggs set, hatchability of eggs set and pullet day-old chicks hatched was studied to apply the presence of this interaction for improving chicken production in South-west Nigeria. Interaction was investigated by the Factorial ANOVA method of SAS (1999). Results revealed that interaction in day-old chicks production between the two genotypes was due mainly to change in scale and change in rank in the late dry season. The knowledge of genotype-season interaction could be useful in the planning of stocking dates of commercial layer chicken enterprises in the environment.

Keywords: Day-old chicks, Genotype-season interaction, Hatchability, Change in Rank, Change in Scale.

An Article presented at the Scientific Session of Animal Science Association of Nigeria – Nigeria Institute of Animal Science Joint Annual Meeting 2014, Held at The International Conference Centre, University of Ibadan, Oyo State, Nigeria, September 7-11, 2014.

Introduction

Genotype x Season interaction can be defined as the change in the relative performance of a genotype, e.g. broiler live weight at 8 weeks, when reared under two or more seasons[1]. This response of a genotype to a change in an environmental factor (e. g. season) is sometimes called a reaction norm. Many unpublished results on Tropical farms indicated this phenomenon when production and reproduction results fail to match the published information of parent breeding companies. It has also been observed that in an environment with different seasons, each change in season brings about a specific and different effect on each genotype. An interaction therefore results when the change in season does not have the same effect on different genotypes[2]. Since a single genotype is a genetically uniform group, the variance observed on the genotype will entirely be due to seasonal differences among individuals within the genotype. The phenotypic value of an individual in a genotype then will become:

$$\text{Phenotype} = \text{Genotype} + \text{Environment} + \text{Interaction}_{G.E}.$$

Thus the variance due to GxE interaction is regarded as part of the environmental variance in (V_E). The study investigated genotype x season interaction in the breeding of two parent-stock chickens namely ISA brown (IB) and Bovan Nera (BN); and the application of this phenomenon to improving commercial chicken production under the hot humid conditions of Ibadan in South-west Nigeria. The tested hypothesis was that both genotypes in the study will respond insignificantly to different seasons.

H_o: BN = IB

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H_1: BN ≠ IB

Both genotypes were bred and managed under same feeding regime and management but with many batches reared in different seasons. Batches within each season were used as replicates because preliminary ANOVA results indicated lack of significant differences *($P<0.05$)* among them.

Materials and Methods

Records on Bovan Nera (BN) and ISA Brown (IB) Parent-stock chickens were obtained from Ajanla Farms, Ibadan Nigeria, using 24 batches of each hybrid from 1999 to 2008. These included cock weight (CW), hen weight (HW), Hen-house production (HHP), egg weight (EW), fertility of eggs set (FES), hatchability of eggs set (HES) and pullet day-old chicks (PDC) hatched. The data was partitioned into seasons namely early wet (EW, April-July); late wet (LW, August-October); early dry (ED, November-January) and late dry (LD, February-March) for the study. Data were subjected to descriptive statistics, ANOVA, t-test and Duncan Multiple range test ($p<0.05$)[3]. Experimental design was randomized complete block. Statistical interaction was examined by factorial ANOVA[3]. Microsoft Excel software[4] was used to plot the interaction between genotype and season (G x S).

Results

Table 1 presents the seasonal weather parameters of the study area. This revealed that there were significant differences between seasonal weather parameters within the period covered by the data. This meant that the seasons were different *($p<0.05$)*, and distinguishable from each other statistically. The table further revealed that Late-wet season between August and October was the wettest month with rainfall, humidity and number of rainy days per month of 174.43 cm, 82% and 14 respectively. This period had the lowest sunshine hours, wind speed and atmospheric temperature of 16 hours, 2.1 km/hr and 25.24^{o}C respectively. The other seasons - Early-wet, Late-dry and Early-dry - followed in decreasing order of rainfall pattern respectively.

Table 2 revealed the presence of genotype-season (GxS) interaction when genotypic values were compared between seasons at parameter levels, although ANOVA indicated no significant *($p>0.05$)* presence of G x S. The table shows that IB had superior reproductive values of FES, HES and PDOC (%) values in Late wet season (**89.45 vs** 86.23**, 73.88 vs** 73.13 and **35.74 vs** 34.56) while BN recorded superiority in Late dry season (84.20 **vs 84.57**, 67.73 **vs 70.36** and 32.44 **vs 33.02**) respectively.

Discussion

This result could mean that Isa Brown and Bovan Nera strains bred to their genetic – environmental optimum potentials in Late wet and Late dry seasons respectively. This interaction suggested a re-ranking of the order of superiority of the genotypes between seasons, and that IB could breed better to type and potential in cool and humid conditions (25.24$^{\mathbf{o}}$C and 82.00% RH) while BN could tolerate and survive fairly well in hot and dry conditions (28.7$^{\mathbf{o}}$C and 65.45 % RH). The best season for reproduction, as revealed from Table 2, in both strains was the cooler Late wet season (6.17^{O}C and 82.00%RH). Utilizing the weather, production and interaction results for the benefit of commercial strains could mean managing these two strains so as to come into production during the late Wet and late Dry seasons respectively. The graph of seasonal day-old chicks production (Figure 1) showed that Isa Brown had the higher scale between the two genotypes of the day-old chicks produced in three (EW, LW and ED) out of the four seasons of the year. This revealed that change in scale (level) of production was responsible mainly for the genotype-season interaction observed between the two strains. Since the seasons were closely interwoven in the environment and could not be practically demarcated from each other in reality, and genotype-season interaction was not significant (p>0.05) statistically, then specialized breeding of the genotypes for specific seasons was not advised in the environment. However they could continue the culling of defective and less-fit animals within genotypes in order to maintain their genetic quality and productivity in the environment. From the findings of this research, it is evident that the environment requires chickens that are consistent in production across environments. Then the important question was which genotype was most stable over environments since one could not control environment - this requirement could best be fulfilled by an improved native chicken breed but till then producers will continue to test for stable and consistent exotic genotypes to rear in the environment. Results also showed that Isa Brown was most consistent of the two strains across the seasons as in Figure 1.

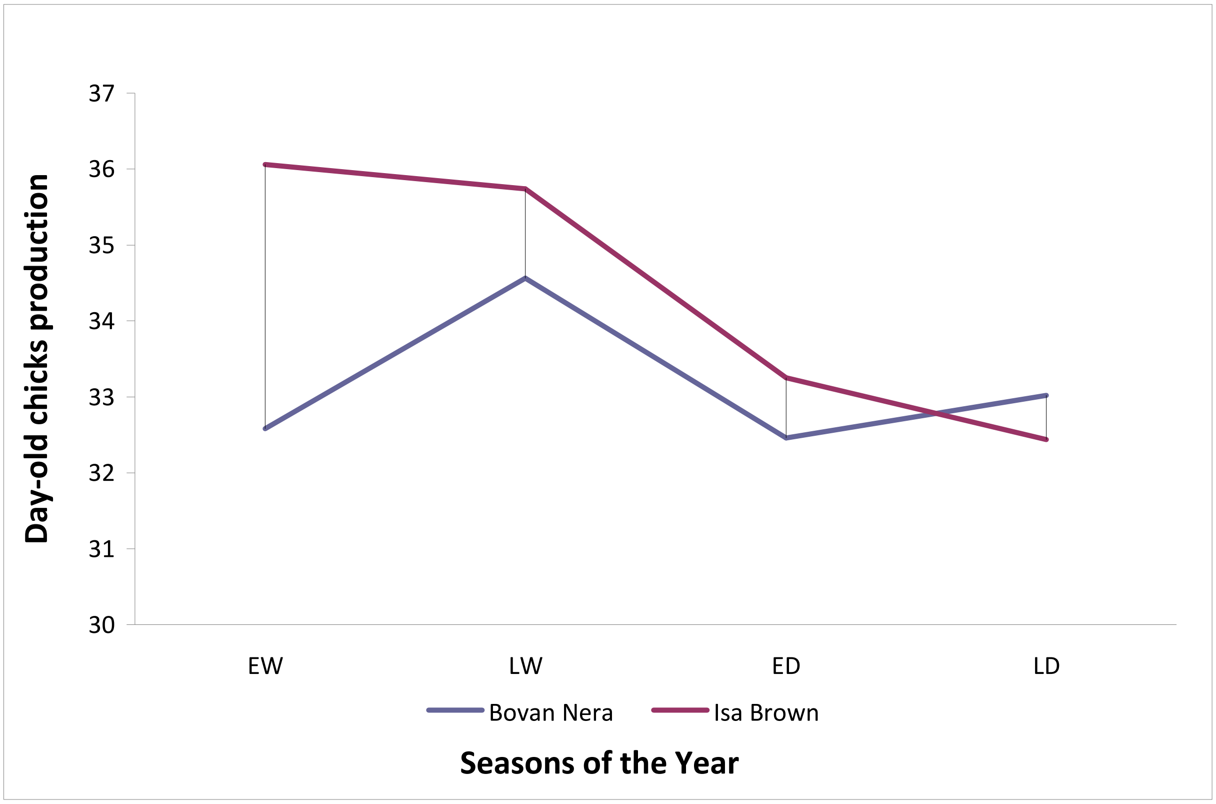

Figure 1: Seasonal day-old production in Isa Brown and Bovan Nera Parent Stock chickens in South-west Nigeria

The magnitude of genotype × environment interaction (G×E) for yield, health and fertility traits in dairy cattle was investigated using random regression models and it was concluded that G×E is relatively unimportant for health and fertility traits[5]. The possible effect of GxE by estimation of the genetic correlation for respective traits in different environments was also investigated. Results revealed that Body Weight and Greasy fleece weight were affected at a higher level of GxE interaction compared to the other traits. Furthermore, the small GxE interactions obtained did not led to a large-scale re-ranking of sires in different production environments[6]. A group reported that identification of G×E is necessary when considering turkey breeding programme. Egg production, fertility, and hatchability in turkeys could be considered as 2 distinct traits in an animal model based on season of lay. Re-ranking based on the genetic prediction of turkey egg production, fertility, and hatchability in different seasons was indicative of a potential G×E interaction[7]. G x E interaction for production and fertility was studied in 927 929 milk recording data. Records were analyzed to predict reaction norms for young bulls of the Nordic Red dairy breeds. Results showed that the genetic parameters change over environments, which were measured on a continuous scale across countries. There was little re-ranking of sires, except between extreme environments[8].

Conclusion

Farmers could utilize the knowledge of genotype-season interaction to plan stocking and management operations in order to increase productivity and profit in the area.

Tables

Table 1: Mean Seasonal Weather Parameters of Ibadan in South-west Nigeria covering the period of data between 1999 and 2008.

Season	**E-wet**	**L-wet**	**E-dry**	**L-dry**
Period	April-July	Aug-Oct	Nov-Jan	Feb-March
Rainfall (cm)	174.08^{a}	174.43^{a}	11.01^{b}	41.29^{b}
Sunshine hours	8.95^{a}	6.17^{b}	8.27^{ab}	10.41^{a}
Wind speed (km/hr)	2.78^{b}	2.1^{c}	2.26^{bc}	3.57^{a}
Teperature (^{0}C)	26.37^{c}	25.24^{d}	26.99^{b}	28.70^{a}
Relative Humidity (%)	79.53^{a}	82.00^{a}	66.37^{b}	65.45^{b}
Rainy days/Month	12^{b}	14^{a}	1^{d}	4^{c}

Note: Means across rows with different superscripts are significant (P<0.05) different

E = Early; L= late.

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Table 2: Mean Body weight, Productive and Reproductive Output of Bovan Nera and Isa Brown Parent Stock Chickens in Ibadan.

Parameter	Genotype	E-wet	L-wet	E-dry	L-dry	Mean
Cock Weight (gm)	BN	2176.83	2162.93	2115.09	2451.72	2214.14
	IB	2221.87	2112.91	2543.66	2098.98	2226.63
Hen Weight (gm)	BN	1671.00 [y]	1677.74[y]	1669.11[y]	1923.11[a x]	1724.81
	IB	1590.67	1596.93	1497.56	1514.67[b]	1549.83
HHP (%)	BN	60.77	65.57	63.23[b]	61.45	62.73
	IB	66.74	69.38	72.92[a]	67.34	69.08
Egg weight (gm)	BN	56.20[b]	56.68	56.66	54.71[b]	56.05
	IB	59.99[a]	57.97	58.12	56.88[a]	58.23
Fertility of Egg set (%)	BN	80.82[b]	86.23[b]	82.77	84.57	83.61
	IB	88.87[a]	89.45[a]	84.47	84.20	86.70
Hatchability of Egg set (%)	BN	69.08[b]	73.13	68.85	70.36	70.35
	IB	73.59[a]	73.88	68.32	67.73	70.86
Pullet DOC (%)	BN	32.58[b]	34.56	32.46	33.02	33.10
	IB	36.06[a]	35.74	33.25	32.44	34.36

Note: HDP = Hen house production; DOC = day-old chicks; BN = Bovan Nera; IB = Isa Brown
E = Early; L= late; Mean = Environmental Mean for Genotype

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