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Magnitude of the Interaction between Breed, Season and Bird's Body Weight in Determining The Development and Performance of Chickens II-Effect on Growth and Production Traits

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AN experiment was designed using 2400 one day old chicks, to study the magnitude of the interaction between breed, season of hatch and 8 -week-old body weight on growth, sexual maturity, egg production, egg quality and feed consumption. The study included two different hatches (December & May) from each of White Leghorn (W.L.) and Rhode Island Red (R.I.R.) chickens.

The environmental conditions during summer months, showed deleterious effect on all traits studied for both breeds. The birds of R.I.R. showed better growth rate in winter compared to the W.L. birds, while the opposite was obtained in summer. Considering the egg production criterious, W.L. showed, in general, a superiority over the R.I.R.

The interaction effect among the main factors studied was significant only in case of body weight and growth rate, while in case of egg production traits, it was of low magnitude which makes it difficult to put a clear statement about the advantage of a certain genotype in respect to the adaptation to summer season.

Keywords : Chicks, season, body weight, sexual maturity, egg production and quality and feed consumption.

The additive model is often used to illustrate the phenotype of an individual as a function of its genotype, the environmental conditions under which it is kept and the possible interaction between genotype and environment. The existence of genotype environment interaction may mean that the best genotype in one environment is not the best in another environment, so in such cases this interaction must be taken into consideration.

Birds kept in open-sided houses (mainly used in developing countries) are exposed to the seasonal variations in the surrounding environmental factors such as ambient temperature, relative humidity, photoperiod, etc. These seasonal variations (especially temperature) were found to have significant effect on growth and development of chickens (Kamar, 1954; Prince *et al.*, 1965; Huston, 1965; Vo *et al.*, 1978 and Henken *et al.*, 1982, and on egg production and egg quality (Harwitz and Griminger, 1962; Petersen, 1965 and Izat *et al.*, 1985).

The effect of environmental tempereature on the performance of chickens was found to be genotype dependent, so the reactions of heavy populations to temperature change were higher than of light ones (Joiner and Huston, 1957 and Peterson *et al.*, 1976). Furthermore, Petersen and Horst (1978) demonstrated that body weight seems to be a parameter for acclimatization, indicating that genotypes with a lower body weight should be prefered for environments with higher ambient temperature.

The present study was conducted to investigate the effect and the magnitude of the interactions between breed, season and bird's body weight on growth and some production traits of chickens.

Material and Methods

A total of 2400 unsexed one day-old chicks both of White Leghorn (W.L.) and Rhode Island Red (R.I.R.), (1200 birds each) were used in this study. Half the number of chicks of each breed (600 birds) hatched in December, while the second half hatched in the following May.

The day old chicks were wing-banded, weighed and housed in electrically heated and well equipped floor brooder houses.

Brooder house temperature was maintained at a level of about 35± 1°C, 30 ± 1°C, 26.5± 1°C and 23± 1°C during the first, second, third and fourth week of age. Thereafter birds were kept without any artificial heating. Weekly average record of the highest and lowest environmental surrounding temperature is shown in Fig.1

During the first three days birds received continuous light (24 hr /day), thereafter photoperiod was diminished by two hours daily until it reached 14 /day and continued at this level until birds reached sexual maturity (the 23 rd week of age for W.L. and 24th week for R.I.R.), then a constant photoperiod of 16 /day was applied up to the end of experiment.

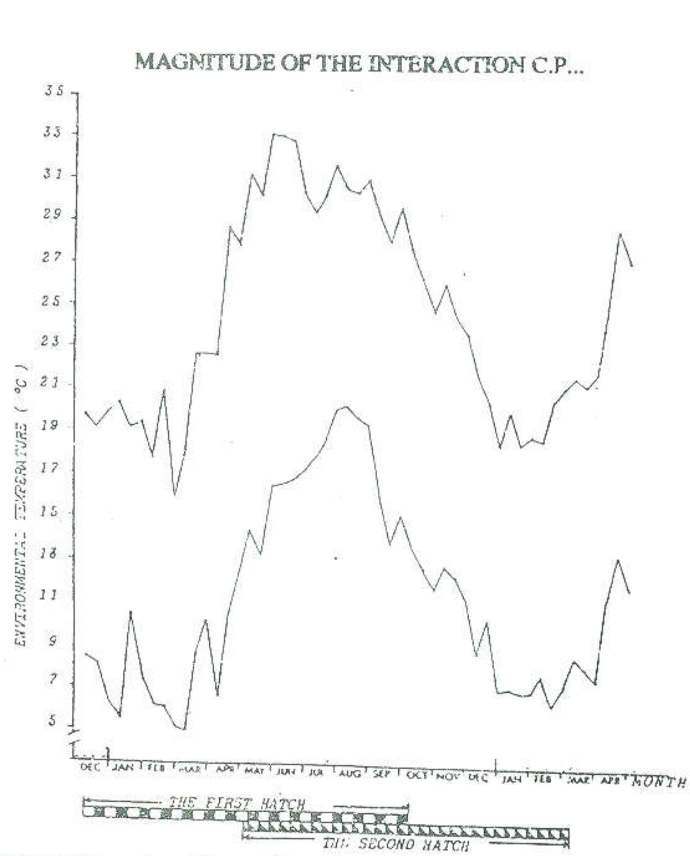

Fig. (1) . Highest (upper) and lowest (lower) values of the average ambient environmental temperature throughout th e ezperimental period.

Birds were fed ad lib according to the recommendations of the NRC, 1977.

At 8 weeks of age, brids were sexed and females were kept for the completion of the study. Pullets of each breed were classified phenotypically according to their individual body weight at 8 weeks into three categories; Heavy (more than $\overline{X}$ + S), Medium (from $\overline{X}$ -- S to $\overline{X}$ + S) and small (less than $\overline{X}$ - S). Body weight was determined at 2 week intervals up to the 8*th* week of age, thenafter it was recorded at 4 week intervals Relative growth rate was calculated as follows:

$$\text{Relative growth rate} = \frac{W_2 - W_1}{1/2\,(W_1 + W_2)} \times 100$$

Where W_1 is the initial weight and W_2 the final weight of a period. Age at sexual maturity was recorded individually as the age at first egg. A total of 480 adult hens (2 breeds X 2 hatches X 3 body weight groups X 40 hens) were kept in individual cages for the test of egg production and feed consumption traits.

The method of "Least Squaes" described by Harvey (1960) was used for the analysis of variance of the data. Treatments were compared using the multiple range test (Duncan, 1953). The next mathematical model was followed:

$Y_i jkl$ = $u + S_i + B_j + G_K + (SB)_{ij} + (SG)_{jk} + (SBG)_i jk + e_i jkl$;

$Y_i jkl$ = $l th$ observation in $k th$ body weight groups of $j th$ breed and ith season,

u = Overall mean,

S_i = Effect of i *th* season (i=1,2)

Bj = Effect of j *th* breed (j = 1,2)

G_k = Effect of k *th* body weight group (K = 1,2,3),

$(SB)_{ij}$ = Effect of interaction between i *th* season and j *th* breed,

(SG) ik = Effect of interaction between i *th* season and k *th* group,

$(BG)_{jk}$ = Effect of interaction between j *th* breed and k *th* group,

$(SBG)_{i\ jk}$ = Effect of interaction between i *th* season, j *th* breed and k*th* group, and

$e_i jkl$ = Random error $(0, \hat{0^2} e)$.

Results and Discussion

Body weight and growth rate

Means of body weight and growth rate are shown in Tables 1 and 2. It is clear that body weight and growth rate were in general significantly affected by time of hatch. However, up to 4 weeks of age, this effect had no biological significant means. After 6 weeks of age and during the growing period, the winter hatched birds exceeded that hatched in summer in their growth rates. According to the findings of Henken *et al.* (1982), these results could be explained through the suitable climatic conditions during the winter period of the year compared to that in summer.

The differences between breeds in growth rate were significant at least during the first 16 weeks of age. These differences were in favor of R.I.R in winter hatch and of W.L. in summer hatch. That means an important role of the interaction between breed and season of hatch, which was statistically proved in the early age of growing period through the analysis of variance. The W.L. breed seems to be more adapted to the summer conditions compared with the R.I.R.

The classification of birds at 8 weeks of age to three body weight groups caused clear differentiations among groups not only at 8 weeks but also at all other ages (Table 1), which indicated a high repeatability of body weight.

TABLE 1. Body weight ($\bar{X} \pm$ S.E.) during the growing period for the three body weight groups of the two breeds from two different hatches.

Season of hatch	Breed	Group	0 wks.	4 wks.	8 wks.	12 wks.	16 wks.	20 wks.
Winter hatch (December)	W.L	H	38.2 ± 0.4^{a}	141.5 ± 4.1^{a}	482.9 ± 5.6^{a}	843.9 ± 11.3^{a}	10820.0 ± 17.1^{a}	1289.0 ± 20.5^{a}
		M	37.9 ± 0.7^{a}	129.5 ± 3.9^{ab}	400.0 ± 0.0^{b}	775.0 ± 15.9^{b}	1007.1 ± 21.5^{a}	1191.1 ± 28.2^{ab}
		L	39.5 ± 0.6^{a}	105.9 ± 3.5^{ab}	307.7 ± 6.2^{c}	667.9 ± 14.8^{c}	894.9 ± 17.1^{b}	1084.6 ± 15.7^{a}
		Average	38.5±0.5	125.6±10.4	396.9±50.6	762.3±51.2	994.2±53.9	1188.6±59.0
	R.I.R.	H	37.8 ± 0.5^{a}	146.4 ± 2.9^{a}	513.4 ± 11.4^{a}	840.0 ± 10.5^{a}	1191.1 ± 16.7^{a}	1453.3 ± 20.9^{a}
		M	37.4 ± 0.3^{a}	125.3 ± 3.8^{a}	450.0 ± 00.0^{a}	758.1 ± 14.6^{b}	1080.6 ± 21.7^{b}	1335.5 ± 24.9^{b}
		L	36.2 ± 0.6^{a}	118.4 ± 4.6^{a}	369.6 ± 8.2^{b}	665.2 ± 17.1^{c}	850.0 ± 28.1^{c}	1034.8 ± 27.1^{c}
		Average	37.1±0.5	130.1±8.42	444.3±41.7	754.4±50.5	1037.3±98.0	1274.5±124.
Summer hatch (May)	R.I.R.	H	35.6 ± 0.6^{a}	156.9 ± 1.4^{a}	423.4 ± 10.9^{a}	743.8 ± 20.3^{a}	986.3 ± 22.9^{a}	1180.8 ± 31.5^{a}
		M	35.0 ± 0.4^{a}	141.8 ± 4.7^{a}	331.3 ± 3.1^{b}	642.1 ± 17.4^{b}	895.2 ± 15.8^{b}	1161.9 ± 35.0^{a}
		L	32.5 ± 0.8^{b}	121.4 ± 4.9^{a}	247.5 ± 4.9^{c}	511.8 ± 21.1^{c}	725.2 ± 24.4^{b}	977.3 ± 43.9^{b}
		Average	34.4±0.9	140.0±10.3	334.1±50.8	632.6±67.2	869.0±76.6	1106.6±64.9
	R.I.R.	H	40.5 ± 0.4^{a}	156.6 ± 6.9^{a}	375.0 ± 10.0^{a}	726.3 ± 18.5^{a}	1021.1 ± 21.4^{a}	1239.5 ± 24.7^{a}
		M	40.0 ± 0.6^{a}	136.1 ± 4.9^{a}	318.1 ± 05.5^{b}	606.1 ± 23.6^{b}	966.7 ± 47.1^{b}	1136.1 ± 38.9^{b}
		L	37.4 ± 0.7^{a}	108.4 ± 4.5^{a}	241.1 ± 06.6^{c}	497.9 ± 21.6^{c}	744.7 ± 38.9^{c}	1036.8 ± 49.9^{c}
		Average	39.3±0.9	133.7±13.9	311.4±38.8	610.1±65.9	877.5±79.9	1137.9±58.5

a,b,c : Means in each column within hatch and breed having different letters are significantly different at $P\leq 0.05$

TABLE 2. Growth rate (%) during the growing period and age at sexual maturity (days) for the three body weight groups of the two breeds from two different hatches.

Season of hatch	Breed	B. group W.	Growth rate (%) 0-4 wks	4-8 wks	8-12 wks	12-16 wks	16-20wks	0-20 wks	Age at sexual maturity
Winter hatch (December)	W.L	H	114.1^a	109.2^a	54.2^c	24.4^a	17.6^a	188.4^a	171.6^c
		M	108.2^a	102.6^b	63.1^b	26.0^a	16.6^a	187.5^{ab}	179.0^b
		L	89.6^b	97.6^b	73.6^a	29.2^a	19.3^a	185.8^b	190.1^a
	Average		104.0	103.1	63.6	26.5	17.8	187.3	180.2
	R.I.R.	H	117.3^a	112.8^a	46.0^b	33.6^a	20.6^a	189.8^a	178.9^b
		M	106.5^b	113.3^a	50.3^{ab}	34.8^a	21.2^a	189.0^a	176.0^b
		L	104.3^b	102.9^b	56.8^a	23.8^b	20.0^a	186.3^b	190.6^a
	Average		109.3	109.7	51.0	30.7	20.6	188.4	181.6
Summer hatch (May)	W.L.	H	125.0^a	91.6^a	54.6^b	28.1^a	17.7^b	188.1^a	179.9^b
		M	120.3^{ab}	79.9^b	63.1^{ab}	33.2^a	25.3^a	188.1^a	179.0^b
		L	114.4^b	68.8^c	68.0^a	34.8^a	27.9^a	186.2^a	184.1^a
	Average		119.9	80.1	61.9	32.0	23.7	187.5	181.0
	R.I.R.	H	115.7^a	82.6^a	53.0^b	33.9^a	19.3^b	183.1^b	182.6^b
		M	108.1^a	80.5^a	61.1^{ab}	35.7^a	26.6^a	186.2^a	186.4^b
		L	96.0^b	76.1^a	68.3^a	38.6^a	32.6^a	186.5^{ab}	191.6^a
	Average		106.6	79.7	40.5	36.1	26.2	184.9	186.9

a,b,c : Means in each column within hatch and breed having different letters are significantly different at $P \leq 0.05$

The interaction effect between breed or genotype and season can be detected through the comparison between breeds or genotypes under the different seasons. By looking to the results in Table 1, one can see that the differences between the two breeds in summer are not equal to that in winter. Also the differences between breedss were changeable according to the body weight group (Fig.2) These results indicate the existance of the interactions among the main factors in the model. The deterioration of body weight and growth rate at 8 weeks of age and after in summer hatch compared with winter hatch was more severe in R.I.R. than in W.L., indicating that W.L. is more adapted to summer. Also, the deterioration was greater in the heavy and medium groups than in the low body weight group, which indicated that the light birds are more adapted to the summer conditions than the medium or heavy birds.

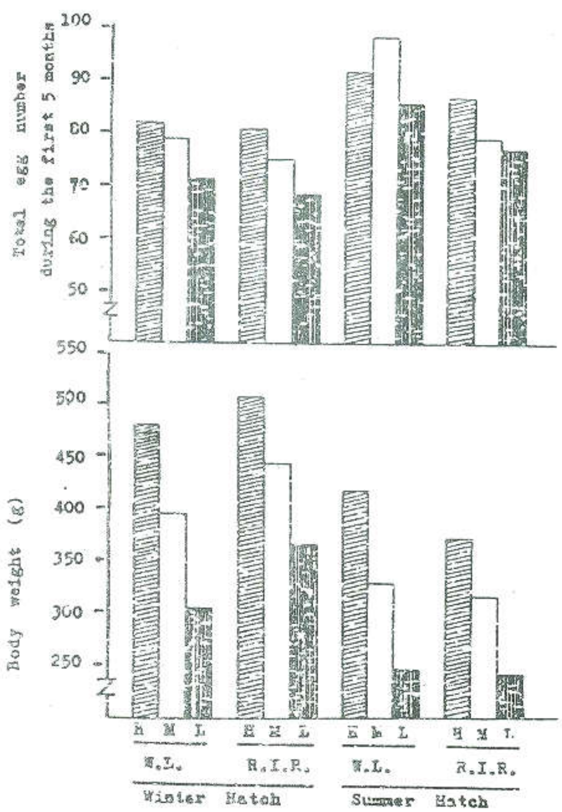

Fig. (2). Egg number during the first five months (upper) and body weight at the age of 8 wks (lower) to show the interaction effect of season of hatch, breed and body weight group.

The relatively good adaptation of the light breed and light body weight could be explained that the light birds are more able to eliminate the excess of heat production under the high ambient temperature in summer. However, the statistical analysis showed that at the level of $p < 0.05$ only the interaction between hatching season and breed was significant in many cases.

The present results seem to be in agreement with those reported by Horst and Petersen (1975), Petersen *et al.* (1976), Petersen and Horst (1978) and Horst and Petersen (1981). They concluded that genotypes with a lower body weight should be prefered for environments with higher ambient temperature.

Age at sexual maturity

Table 2 includes the means of age at sexual maturity for the different experimental groups studied. It could be generally observed that birds hatched in winter reached sexual maturity earlier than birds hatched in summer especially in R.I.R. pullets. However, statistical analysis showed that the differences between hatches was not significant, which could be partially attributed to the use of the same light regime in both hatches. This was confirmed by Kato and Konishi (1968) who reported that sexual maturity was dependent on the photoperiod.

Birds of W.L. breed reached sexual maturity earlier than that of R.I.R. This result is to be expected since the light breeds mature earlier than the heavy ones. However, the differences between the two breeds were not statistically significant ($P > 0.05$).

The results found in Table 2 showed that heavy body weight groups reached sexual maturity earlier than the medium and light body weight groups. It seems that body weight within breed is correlated with the development of the other organs including sex organs. The negative relationship between body weight and growth during the growing period and sexual maturity was reported by Horst and Petersen (1977), Saleh (1983), Benoff and Renden (1983) and Brody *et al.* (1984). It has been postulated that there exists a threshold body weight for each strain of birds below which hens fail to enter sexual maturity and lay (Sollar *et al.*, 1982 and Dunnington *et al.*, 1983).

Results of the analysis of variance revealed no significant effect of any of the interactions in the model. That means that the three main effects considered in the model (breed, season and body weight group) are independent in their effects on age at sexual maturity. This results is in agreement with that found by Horst and Petersen (1981) who reported a low magnitude of the interaction between genotype and temperature in respect with their effect on age at sexual maturity.

Egg production

Means of egg number produced during the test period (the first 5 months of production) are shown in Table 3. Egg production was deteriorated during summer months. The main cause could be the high ambient temperature during summer months and its effects on the different physiological characters. Little differences between breeds have been detected in egg number in favor of W.L., although the differences were statistically nonsignificant. Under Egyptian conditions, White Leghorn breed was found to produce more eggs than R.I.R. (Mostageer, 1958 and Amer, 1964).

During the first months of production, statistically significant differences were observed among the three body weight groups in favour of the heavy group, which were reflected in the total egg number. These results had been also confirmed by Reinhart and Jermo, 1970; Singh and Nordskog, 1982 and Summers and Lesson, 1983, who reported that egg production seemed to be significantly lower for lighter birds.

TABLE 3. Means of egg number in 5 months for the three body weight groups of the two breeds in two hatches.

Season of hatch	Breed	Group	$\bar{X}$ egg number					
			No.1	No.2	No.3	No.4	No.5	Total
Winter hatch (December)			June	July	August	Sept.	Oct.	
	W.L.	H	5.12^{a}	14.67^{a}	20.40	20.90	22.10	83.19
		M	3.50^{ab}	12.30^{a}	21.20	21.80	21.00	79.80
		L	1.12^{b}	6.60^{b}	20.20	22.60	21.20	71.72
		Average	3.21	11.19	20.60	21.76	21.10	78.90
	R.I.R.	H	2.90^{ab}	14.22^{a}	23.12	22.30	19.70	82.24
		M	3.60^{ab}	13.30^{a}	19.06	20.60	19.40	75.96
		L	0.52^{b}	7.29^{b}	19.60	22.20	19.30	68.91
		Average	2.34	11.60	20.59	21.70	19.46	75.70
Summer hatch (May)			Nov.	Dec.	Jan.	Feb.	March	
	W.L.	H	10.40^{a}	20.50^{ab}	21.60	21.31	19.00	92.81
		M	10.60^{a}	23.07^{a}	24.00	24.00	18.00	99.67
		L	4.70^{b}	20.20^{ab}	22.52	22.11	18.00	87.53
		Average	8.96	21.46	22.70	22.47	18.33	93.33
	R.I.R.	H	9.00^{ab}	20.60^{ab}	21.42	20.90	16.41	88.33
		M	6.80^{ab}	18.20^{b}	18.61	18.63	17.90	80.14
		L	6.20^{ab}	17.11^{b}	20.03	18.31	16.22	77.97
		Average	7.33	18.63	20.02	19.28	16.87	82.14

Mo. = Month of production

a,b,c = Means with different superscripts within hatch and month are significantly different ($P \leq 0.05$).

The depression of production during summer months, compared with that in winter, was higher in W.L. breed than in R.I.R. and the medium body weight group of W.L. showed the severest depression (Fig. 2) However the statistically non significant effects ($p>0.05$) of the interaction components in most cases make it difficult to put a clear statement about the advantage of a certain genotype in egg production in respect of the adaptation to the summer season. Contrarely Petersen *et al.* (1976) stated that heavy birds showed a greater depression under heat stress than the light birds. Hussain *et al.* (1982) demonstrated a significant interaction between body size and climatic conditions (temperate and tropical environments) with regard to body weight gain, total egg production and total egg mass in favor of smaller sized birds.

Egg weight

In general results obtained showed no clear differences in egg weight between the eggs produced in summer or in winter, indicating a low magnitude for the effect of season on egg weight (Table 4). On the other hand, W.L. breed exceeded R.I.R. in egg weight (Table 4) and the differences were statistically significant but not in all months of production. This results is in agreement with that reported by Amer (1965).

TABLE 4. Means of egg weight in 5 months for three body weight groups of the two breeds in two batches.

Season of batch	Breed	Group	$\bar{X}$ egg weight No.1	No.2	No.3	No.4	No.5
Winter hatch (December)			June	July	August	Sept.	Oct.
	W.L.	H	49.96^{a}	52.81	57.42	57.12	57.02
		M	47.20^{ab}	52.11	55.91	56.71	57.61
		L	47.30^{ab}	50.32	54.71	55.21	54.81
	R.I.R.	H	46.21^{ab}	50.71	53.62	54.61	54.13
		M	45.52^{ab}	50.42	53.13	54.32	54.21
		L	37.61^{b}	47.31	51.31	52.41	52.31
Summer hatch (May)			Nov.	Dec.	Jan.	Feb.	March
	W.L.	H	48.91^{a}	53.03	57.81	59.22	58.81
		M	47.62^{a}	50.12	55.13	56.81	56.22
		L	48.00^{a}	50.71	55.22	56.91	57.13
	R.I.R.	H	44.51^{a}	48.61	52.13	54.81	55.71
		M	43.03^{a}	49.21	51.31	53.03	52.61
		L	40.52^{a}	47.51	49.13	51.07	53.12

Mo. = Month of production.

a,b = Means with different superscripts within hatch and month are significantly different ($P \leq 0.05$).

The results also showed that heavy body weight groups produced heavier eggs than those of medium and low body weight groups specially in the first two months of production. This result is in agreement with those of Horst and Petersen (1977), Madrid *et al.* (1981), Singh and Nordskog (1982) and Ruiz *et al.* (1983). The earlier development and growth of the body and organs seems to be correlated with early sexual maturity, higher egg number, egg weight and egg mass at least in the first few months of production.

The statistical analysis showed generally that the interactions between the main factors were not significant,which indicated that breed, season and body weight group were independent in their effects on egg weight. On the other hand, Hussain *et al.* (1982) demonstrated a significant interaction between body weight groups and climatic conditions in affecting total egg mass. This contradiction may be due to the differences in the environmental conditions in both studies.

Egg quality

The results found in Table 5 showed that egg quality characters were in general significantly affected by time of hatch and breed but not affected by body weight group. Eggs produced during January and March (from summer hatch birds) had better quality than those produced during August and October (from winter hatch birds). The main cause could be the climatic conditions during production period. The deterioration of egg quality during summer season was reported by Kamar (1954) Hurwitz and Griminger (1962), Miller and Sunde (1975), Vo *et al.* (1980), 1954 and Izat *et al.*(1985). Eggs produced by W.L. birds generally showed better quality than those produced by R.I.R. On the other hand the nonsignificant effect of body weight group indicated that egg quality traits are independent from body weight of birds at 8 weeks of age.

The results obtained from this study showed that the main factors studied were acting independently. So, the statistical analysis showed generally that the interactions among the main factors in case of egg quality were nonsignificant, which means that breed or body weight could not be considered as criterions of adaptation to specific season. However, Clark and Amin (1965) reported that genetic temperature relationship could be defined for egg Haugh units and percent shell but not for shell thickness.

Feed consumption and feed efficiency

The environmental conditions during summer months caused a reduction in feed consumption in order to reduce heat production and keep the body temperature within normal. It caused not only a low feed consumption, but also a bad feed conversion (Table 6). This result is similar to that of Vo *et al.* (1978) and Henken *et al.* (1982).

TABLE 5. Egg quality characteristics for the three body weight groups of the two breeds from two different hatches at 30 and 40 wks of age.

Season of hatch	Breed	Group	Specific gravity	Albumin height (cm)	Shell thickness (mm)	Shape index %	Yolk index %	Yolk wt. %	Shell wt. %	Albumin wt. %
			Average values at 30 weeks of age							
Winter hatch (December)	W.L.	H	1.084	0.67	0.34	66	47	28	10	62
		M	1.085	0.71	0.34	69	47	27	09	64
		L	1.084	0.66	0.34	68	46	28	10	62
	R.I.R.	H	1.080	0.56	0.33	76	44	28	09	63
		M	1.078	0.61	0.31	76	45	28	09	63
		L	1.082	0.63	0.31	77	45	28	10	62
Summer hatch (May)	W.L.	H	1.090	0.78	0.39	68	50	29	10	61
		M	1.091	0.77	0.39	70	48	28	11	61
		L	1.092	0.79	0.38	69	50	28	11	61
	R.I.R.	H	1.084	0.72	0.35	70	47	31	10	59
		M	1.083	0.70	0.36	76	47	29	10	61
		L	1.081	0.61	0.38	76	47	30	10	60
			Average values at 40 weeks of age							
Winter hatch (December)	W.L.	H	1.082	0.55	0.33	66	45	31	09	60
		M	1.082	0.52	0.32	69	44	31	09	59
		L	1.082	0.52	0.32	70	44	31	10	59
	R.I.R.	H	1.081	0.53	0.30	70	43	31	10	59
		M	1.079	0.48	0.29	72	43	32	11	57
		L	1.077	0.58	0.29	71	43	32	10	58
Summer hatch (May)	W.L.	H	1.090	0.75	0.37	67	51	30	10	60
		M	1.093	0.74	0.47	68	50	30	10	60
		L	1.090	0.76	0.37	66	50	30	11	59
	R.I.R.	H	1.086	0.69	0.36	68	48	31	11	58
		M	1.085	0.75	0.36	68	49	31	11	58
		L	1.088	0.72	0.36	73	47	31	11	58

TABLE 6. Means of feed consumption (g/bird/month) in 5 months during the laying period and average feed efficiency as affected by season of hatch, breed and body weight groups.

Season of hatch	Month of production	Breed	Group	Month of production 1	2	3	4	5	Average feed efficiency
Winter hatch			H	3485^{a}	3469	3568	3571^{a}	3556^{a}	3.790
	Jan.	W.L.	M	3475^{a}	3445	3557	3569^{a}	3537^{ab}	3.964
	to		L	3430^{b}	3442	3545	$3552a^{b}$	3519^{b}	4.361
	Oct.		H	3502^{a}	3476	3551	3572^{a}	3547^{a}	4.030
		R.I.R.	M	3475^{a}	3458	3537	3542^{c}	3527^{ab}	4.365
			L	3469^{ab}	3470	3542	4541^{b}	3490^{c}	4.942
		W.L.	H	3498^{ab}	3520	3543	3524^{a}	3591^{a}	3.383
Summer hatch	Nov.		M	3458^{b}	3471	3531	3528^{a}	3588^{a}	3.218
	to		L	3458^{b}	3520	3543	3521^{a}	3561^{a}	3.620
	March	R.I.R.	H	3519^{a}	3484	3513	3513^{a}	3583^{a}	3.846
			M	3476^{ab}	3511	3505	3499^{a}	3583^{a}	4.316
			L	3471^{ab}	3539	3546	3497^{a}	3577^{a}	4.580

a,b,c : Means with different superscripts within hatch and month are not significantly different ($P < 0.05$).

Considering feed efficiency, W.L. breed showed better results than the R.I.R., which was a result of the superiority of W.L. in egg production and egg weight.

The results also showed that in most cases, heavy body weight groups consumed more feed than the medium and light groups. However, because of the better productivity of the heavy groups specially in the first period of production, these groups showed better efficiency of feed utilization in spite of the relatively higher feed consumption (Table 6).

Horst and Petersen (1977), Bell *et al.* (1981) and Harms *et al.* (1982) found that birds with lighter body weight consumed less feed and converted feed to egg mass more efficiently. The disagreement of the results herein with those in the literature may be due to the relatively short term test of egg production in our experiment.

The analysis of variance showed generally that the interactions between the main factors studied had no significant effects on feed consumption. The efficiency of feed utilization of the two breeds or the three body weight groups showed similar trends irrespect of the season of hatch. These are not in agreement with the findings of Petersen and Horst (1978) and Horst and Petersen (1981). They concluded that the most pronounced interaction between genotype and temperature was in feed uptake.

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مدى أهمية التداخل بين النوع والموسم ووزن جسم الطائر فى تحديد تطور وكفاءة الدجاج

التأثير على النمو والصفات الانتاجية

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أجريت هذه التجارب لدراسة الى أى مدى يمكن أن يؤثر التفاعل بين التركيب الوراثي وموسم الفقس ووزن الجسم عند عمر ٨ أسابيع على صفات النمو والنضج الجنسى وانتاج البيض ونوعيته وكذلك على معدل الاستفادة من الغذاء . واشتملت الدراسة سلالتين من الدجاج البياض هما (اللجهورن الأبيض والرودأيلاند الاحمر واستخدم فيها عدد ٢٤٠٠ كتكوت عمر يوم من موسمى فقس مختلفين (ديسمبر ، مايو) ، وعند عمر ثمانية أسابيع تم تقسيم الطيور حسب وزن الجسم الى خفيفة ، متوسطة ، ثقيلة وذلك لتقييم السلوك الانتاجى للطيور تبعا للعوامل الثلاثة تحت الدراسة .

ولقد وجد أن الظروف البيئية خلال الصيف كانت ذات تأثير سلبي واضح على كل الصفات المدروسة في كل من السلالتين . وكان من الملاحظ أن طيور الرودأيلاند تميزت بمعدل نمو أعلى خلال الشتاء عن اللجهورن الابيض بينما العكس كان شاهدا خلال الصيف . وفيما يتعلق بصفات انتاج البيض فقد تفوق اللجهورن الأبيض بصفة عامة على الرودأيلاند الأحمر.

وبالنسبة للتداخل بين العوامل المدروسة فقد كان تأثيره معنويا فقط في حالة وزن الجسم ومعدل النمو بينما كانت قيمته ضئيلة في حالة انتاج البيض مما يجعل من الصعب الخروج برأى قاطع حول تفوق أحد السلالتين في التكيف مع الظروف المناخية لفصل الصيف.