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PRODUCTIVE PERFORMANCE OF THREE STRAINS OF PIGEONS (COLUMBA LIVIA DOMESTICA) UNDER EGYPTIAN CONDITIONS.

Ahmed O.[1], Bahie El-Deen M.[2], Abaza I. M[1] & Abou Khadiga G.[1]*

1Fac. of Des. and Enviro. Agric., Fuka, Matrouh Uni. Matrouh, Egypt.

2Fac.of Agric.(El-Shatby), Alexandria Uni., Alexandria, Egypt.

Corresponding author: Abou Khadiga G.[1] Email**:** galal.aboukhadiga@mau.edu.eg

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ABSTRACT: This study was conducted to evaluate the growth performance of three strains of pigeons (the Local Egyptian pigeon, the Zagel pigeon, and the White Myrthes pigeon. A total number of 475 birds from the three strains were used to study live body weight at hatch, 1, 2, 3, and 4 weeks of age, and at sexual maturity, as well as growth rate between 0-1, 1-2, 2-3, 3-4, and 0-4 weeks of age. The results of body weight showed that Zagel and White Myrthes pigeons are superior to Local Egyptian pigeon in hatch weight and body weight at 7 days old then White Myrthes became the heaviest in later ages, while Local Egyptian pigeons was the lightest in all ages. Growth rate recorded the highest values in the first week of age (162-163 g) then decreased gradually to reach the minimum rate between 21 to 28 days old. White Myrthes has significantly faster growth during the whole period of study from hatch to 4 weeks of age (TGR). Estimates of heritability for body weights and growth rate showed moderate heritability expect for growth rate in the third week of age. The estimates ranged from 0.21 to 0.28 and from 0.09 to 0.28, for body weight and growth rate, respectively. Phenotypic correlations among body weight traits and growth rate traits were mostly high and positive which ranged between 0.63 to 0.82 and 0.12 to 0.77, respectively. Genetic correlation between the same traits were positive and ranged between 0.70 to 0.96 for body weight and 0.20 to 0.88 for growth rate. From the current results, White Myrthes strain was superior in most of the studied traits which give the possibility to involve it in future genetic programs for improving pigeon growth traits.

Keywords: Pigeon, growth, body weight, genetic parameters**.**

INTRODUCTION

It is known that the consumption of meat has increased dramatically in recent years, especially regarding poultry meat, and this increase is likely to continue throughout the world (Henchion, *et al*. 2014). In low income countries the demand in 2030 for poultry and eggs is predicted to be a 301, and 208 % increase over that in 2000, respectively (FAO, 2011). This leads scientists to give more attention to developing the productivity of different poultry species. Pigeon is one of the oldest poultry species that has been domesticated by humans. Domestic pigeon (Columba livia) was pivotal in Darwin's studies as a model organism in the fields of behavior, genetics, and evolution (Smith et al., 2022). Worldwide and in Egypt, modern and historical several purposes for rearing pigeons could be summarized as biological and taxidermy studies, transmit messages as ancient Egyptians used it, human entertainment as ornate appearance, pets, and human sport, and finally, and most important purpose as a meat source (Al-Barwari and Saeed 2012; Attia and Salem, 2022). Meat-type pigeon should have a superior growth performance, which is affected by genetic and non-genetic factors (Narinç et al., 2010; Ojedapo and Amao, 2014 and Abou Khadiga et al., 2018). Growth rate is an economic trait in poultry production which is affected by genetics and environmental factors from embryonic phase up to fully grown age. It can be expressed as an increase body weight per time unit (Putra et al., 2020).

A breeding objective is the improvement of economically beneficial traits. This needs to target the 'ideal' animal as a producer aim to select and breed. Hence, concrete animal breeding programs to improve the productivity through crossbreeding and selection including the estimation of genetic parameters to understand the genetic mechanism are required (Abou Khadiga, 2008). A Genetic improvement program includes perquisite steps which is recoding the phenotypic performance for the interested traits Mbap (1985), then to design a suitable program according to the genetic characterization of such traits (Bhowmik and Khan, 2021). The remarkable improvement in the productivity of many poultry species is due to selection programs that focused on rapid growth with not neglecting environmental factors such as feeding and housing systems (Ahmed, 2012).

Many studies have evaluated the genetics of growth performance of different poultry species estimating the genetic parameters of the growth traits as in chicken (Radwan et al., 2018 and Berger et al., 2022), quail (Farahat et al., 2018 and Sarvari-Kalouti et al., 2023), and ducks (Cyriac et al., 2020 and El-Deghadi et al., 2022). However, the available information on pigeon productivity is very scarce as pigeons did not receive the required attention through genetic improvement systems, as well as from the side of care and nutrition. Therefore, this study aimed to evaluate the productive performance of three strains of pigeons under Egyptian conditions for the possibility of using them as one of the sources of obtaining animal protein.

MATERIALS AND METHODS

Location: This study was conducted on a private farm in Matrouh Governorate, Egypt from November 2020 to June 2022

Birds:

The distribution of birds in different strains over generations is shown in Table 1.

Local Egyptian pigeon

This strain s bred in most areas in Egypt and characterized by large phenotypic and productive differences among its members.

Zagel pigeon

Zagel or racing pigeons had been established by Belgians through the crossing of free-living pigeons with several types of domestic pigeons for the improvement of fitness and homing ability (Ramadan *et al.*, 2018).

White Mirthys breed:

This breed is one of the new pigeon breeds established for meat production by the Grimaud Freres Company in France **(El-Khouly 2019).**

Stock management:

The pigeons were housed in wooden cages. The cages were numbered as well as the pigeons were numbered using leg numbers. The sizes of the cages were (60 x 60 x 50) cm in length, width, and height, respectively. According to the sexual behavior of the pigeons, the sexual ratio was 1:1.

Studied traits:

Live body weight.

Squab's live body weight to the nearest gram (BW1, BW2, BW3, and BW4) was recorded at 1, 7, 14, 21, and 28 days of age, respectively, for each breed in the first and second generations. Moreover, the body weight at sexual maturity (BWSM) was recorded for the base population and first generations only.

Growth rate (GR%):

Growth rate (GR%) during the periods 1-7 days (GR1), 7-14 days (GR2), 14-21 days (GR3), 21-28 days (GR4), and total growth rate during the period 1-28 days (TGR) for all breeds at first and second generation was calculated by the following equation (Brody, 1945):

G.R (%) = W2-W1 /0.5 (W2+W1) * 100

Where:

W1 = the weight at beginning of the period,

W2 = the weight at end of the period.

Statistical analysis

A preliminary analysis was performed using Jamovi 2.2. software to obtain least-squares means. Effects of, genetic groups (3 levels), generation (2 levels), hatch (3 levels) and sex were set as fixed effects. Model 1 was used to analyze all traits except for body weight at sexual maturity, which was analyzed with Model 2.

$Y_{ijkl} = \mu + G_i + N_j + H_k + e_{ijkl}$ (Model 1)

Where,

μ = overall mean,

G_i = Genetic group (j = 3),

N_j = generation (i = 2),

H_k = Hatch (k = 3),

e_{ijk}=residual error.

$Y_{ijkl} = \mu + G_i + N_j + S_k + e_{ijkl}$ (Model 2)

Where, the abbreviations are the same as the model 1, plus S = Sex (k = 2),

Data were subjected to analysis of variance by Duncan's multiple range test. (Duncan 1955).

Genetic parameters

Variance and covariance components for growth traits were estimated by animal models using WOMBAT software (Meyer, 2006). The model is represented in matrix form as:

$y = X\beta + Zu + \varepsilon$

where **y** is the vector of observations for the i^{th} trait, β is a vector of fixed effects for the i^{th} trait, u is a vector of random animal effects, X and Z are incidence matrices relating y to the vectors β and u, respectively, and ε is a vector of residual effects for i^{th} trait. It is assumed that u and ε are independent from each other and normally distributed with zero-mean vectors and variance-covariance matrices

G and Σ for genetic and residual effects, respectively. The assumptions in detail are var(u) = A⊗G0, var(e) = I⊗R0, and cov(u, e') = 0, where A is the additive genetic relationship matrix, G0 and R0 are the additive genetic and environmental variance-covariance matrices of the traits, respectively.

Variance components and genetic parameters were estimated using REML procedures. Starting values of population parameters used in calculating breeding values were estimated from data of the base population offspring, the initial population, using the restricted maximum likelihood method (REML). Genetic parameters for the selection experiment were estimated using a multivariate animal model. All analyses included pedigrees back to the base population. Fixed effects included are mentioned above in general statistical models. Additive genetic and residual error effects were included as random effects in the model. In the REML analyses, the convergence criterion for all runs was 10^{-9}. Heritability for the studied traits was estimated according to Willham (1972) as $h^2 = \sigma^2 a/\sigma^2 P$, where $\sigma^2 a$ and $\sigma^2 P$ are the additive genetic and the phenotypic variances of a certain animal for a certain trait.

RESULTS AND DISCUSSION

Due to the lack of previous studies on pigeons, other poultry species will be used in the discussion.

Live body weight

Least-squares means of live body weight at hatch, 1, 2, 3, 4 weeks of age and body weight at sexual maturity (BWSM) in the different genetic groups are presented in **Tables 2 and 3.**

Significant differences were found in all ages among genetic groups. White Myrthes and Zagel breed were similar in BW0 and BW1, then White Myrthes exceeded, significantly *($P<0.001$)*, both Zagel and Local Egyptian pigeon in live body weight in BW2, BW3 BW4 and BWSM. On the other hand, Local Egyptian pigeons was the lightest in all ages with significant differences. Males in the current study were significantly higher in live body weight than females. The difference in body weight at sexual maturity is common in poultry species where males are higher than females, except in quails (Sezer et al. 2006; Tarhyel et al. 2012). The current results were, mostly, in agreement with previous studies on different pigeon strains (Ashraful 2013; Majewska and Drenkowski, 2016; Parvez et al., 2016; Daikwo et al., 2017;; Islam et al., 2021; Ji et al., 2022).

The current result reflects the importance of genetic improvement which can be seen in the superiority of the White Myrthes strain that was genetically improved by the Grimaund Freres company compared to other strains, especially in later ages. However, by comparing BW4 of White Myrthes pigeon in this study with the catalog of the producing company (Grimaund Freres Company**)** in France, still the environmental effects suppress the performance of White Myrthes pigeon in Egypt. The large differences in hatching weight among pigeon strains can be attributed to two reasons. The first is the large difference among strains in body weight due to their genetic background. The second reason is the inaccuracy of recording body weight at hatching, exactly. The pigeon behavior is to feed the young squabs with their crop milk immediately after hatch, which increases the difficulty of weighing birds without crop milk. The performance of Local

Egyptian pigeon was better in the current study than Abou Khashaba et al. (2009) and Abdel-Azeem et al. (2016). This could be due to the expected great variation among flocks of Local Egyptian pigeons. The Local Egyptian pigeon had a few studies to describe and characterize its phenotype and performance. In addition, it did not involve in any program to improve its performance, genetically. Another factor that could interpret the differences among studies on this local strain is the differences in environmental effects such as housing system and nutrition.

Regarding to generation effect there were no significant differences between generations except in BW0. Significant differences *(P<0.05)* were found among hatches at BW1, BW2 and BW3 days of age, the third hatch showed the higher weight. The significant difference between generations in BW0 may be caused by not knowing the exact age of parents of the base generation, which is reflected in egg weight and the amount of crop milk. Attributing the differences to the environmental effects is meaningful as there was no selection occurred in this experiment. In addition, the enhancement in managerial conditions from one generation to another could be reflected in better performance of the birds in this study.

Significant differences among hatches in BW1, BW2, and BW3 were found in the current study. The differences between hatches and the superiority of the third hatch in BW1, BW2 and BW3 could be due to the improvement of experience of the parents in caring their young. Moreover, this superiority in the growth performance of the offspring with age advance of the breeding flock is common in different poultry species (Azhar et al., 2019).

Growth rate

Least-squares means of weekly squabs' growth rate between 0 and 4 weeks of age, and total growth rate between 0 and 4 are presented in Table 4. Growth rate recorded the highest values between hatch and 7 days of age then decreased gradually to reach the minimum rate between 21 to 28 days old. This decrease in the rate of growth with age advanced is a reflection to the relationship between growth rate and feed conversion. Similar results of growth rate were observed in previous studies (Majewska and Drenikowski, 2016; Khalil, 2017).

It is observed in the current study that the growth rate started from very close values for all genetic groups in GR1 (162 to 163 g). The reason for the absence of significant differences in GR1 could be due to that the differences between the weights of birds at early ages were not that large, especially the differences between Zagel and the White Mirthys which was not significant at BW0 and BW1. The absence of significant differences in the early growth rate was observed by Mahmoud and El-Full (2014) in chicken strains. This result in growth rate at early ages agreed with previous studies on different chicken strains (Aly et al. 2005; Amin et al. 2013; Mahmoud and El-Full 2014). After that (GR2) White Myrthes was significantly (*P<0.001*) superior to other genetic groups. It showed about two folds of growth rate compared to Local Egyptian pigeon strain (62.0 vs 37.2), while Zagel strain showed in-between performance (50.7 g). Suddenly after that, White Myrthes pigeon was inferior to the other strains in GR3 and GR4 but without significant differences. In evaluating the total growth rate in the whole period between 0 to 4 weeks of age (TGR), significant (*P<0.001*) differences were found among genetic groups showing that White Myrthes pigeon was the best. Growth rate results in the current study in different periods were close to the results of previous studies (Darwati et al., 2010; Majewska and Drenikowski, 2016; Khalil, 2017; Abdel Fattah et al., 2019).

Regarding to generation effect, significant differences between generations appeared only in GR4 and TGR, where the second generation was better than first generation (*P=0.015, P<0.001*, respectively). Non-implementation of a selection program in the current study makes the environmental factors the most probable reason for such result. There is no constant trend in hatch effect on growth rate. The significant differences between hatches were found in GR2 (the first hatch was the best) and TGR (the third hatch was the best).

Genetic parameters:

Genetic parameters of body weight

Estimates of heritabilities, genetic correlations, and phenotypic correlations among body weight at different ages are presented in Table 5. The current estimates of heritability, which were generally moderate (0.21 to 0.26), could indicate the possibility to conduct a selection program to improve body weight in pigeon. Daikwo et al. (2017) obtained moderate to high estimates of heritability for live body weight at different ages in pigeons (0.24 to 0.51). Increasing heritability estimates with age advance was observed by Resende et al. (2005) in Japanese quail and broiler chicken. Similar observation was noted by Momoh et al. (2013) in pigeon. However, this observation is not agreed with Saatci et al. (2002) and Daikwo (2011) in Japanese quails. The differences in heritability estimates among studies could be attributed to different genetic makeup of herds, and/or using different statistical methods and models for estimating genetic parameters. Positive high genetic and phenotypic correlations were observed in the current study. The current high estimates of genetic correlations between BW1 and the later body weight traits (0.70 to 0.98) could be an indicator to the possibility of using BW1 as an early selection criterion in breeding programs. However, the high genetic correlation between BW0 and BW4 which was 0.78 it not preferable to use due to the inaccuracy in recording BW0 in most studies on pigeon which can lead to misleading results. At hatch time parents immediately feed their young squabs with crop milk. So, recording BW0, separated from crop milk weight in pigeon is very difficult and mostly inaccurate. The current estimates are close to the results obtained by Daikwo et al (2017). The high and positive results of genetic correlations were observed between live body weights at different ages in pigeon could mean that some genes influence in weight at some age have a high impact on other ages.

Genetic parameters of growth rate

The current results of genetic parameters of growth rates were close to Narinc et al. (2014) and Semida et al. (2020). The moderate heritability estimates obtained for GR1, GR2, GR4 and TGR (0.09 to 0.28) indicates the potentiality of using these traits in selection program to improve growth performance of pigeon. Higher response to selection could be obtained through selection for these traits. In contrast, low heritability of GR3 (0.09) in this experiment exclude this trait from the previous assumption. Low heritability estimate of GR3 in this experiment could be attributed to the genetic structure of the flock and the total number of birds used in this study. Positive genetic and phenotypic correlations which observed among most growth rates in the current study agreed with Semida et al. (2020) and El-Full et al. (2021) in Japanese quail. High and positive genetic correlation could be interpreted that the same genes are controlling growth rate during different ages (Momoh et al., 2014). Moreover, genetic correlations can be caused by pleiotropic gene effect which occurs if one locus affects in multiple traits. (Falconer and Mackay, 1996).

CONCLUSION

The current study is considered one of few studies to focus on genetics of pigeon growth in Egypt. From the current results, the superiority of White Myrthes strain in most of the studied traits is clear which reflects the importance of the genetic programs to improve pigeon productivity. Further studies on different pigeon traits are required before generalizing the current results. Anyways, White Myrthes seems to have potentiality to be a pivot in genetic programs of improving pigeon growth characteristics.

Table (1): Distribution of birds in different strains over generations

Genetic groups	Generations	Sire	Dam	Squab	Total
Local Egyptian pigeons	Base population	10	10	-	20
	1st	8	8	50	66
	2nd	-	-	45	45
Zagel	Base population	10	10	-	20
	1st	9	9	53	71
	2nd	-	-	49	49
White Mirthys	Base population	18	18	-	36
	1st	10	10	95	115
	2nd	-	-	53	53
Total number of birds		65	65	345	475

Table (2): Least square mean (± standard error) for live body weight of the three breeds.

	BW0	BW1	BW2	BW3	BW4
Genetic group					
Local Egyptian	14.90 ±0.29[b]	142 ±2.08[b]	214 ±4.15[c]	276 ±4.36[c]	324 ±4.18[c]
Zagel	17.70 ±0.30[a]	171 ±2.43[a]	284 ±3.13[b]	374 ±3.13[b]	398 ±2.42[b]
White Myrthes	17.70 ±0.28[a]	170 ±1.51[a]	320 ±2.86[a]	434 ±2.78[a]	507 ±2.43[a]
P value	< .001	< .001	< .001	< .001	< .001
Generation					
1	17.5 ±0.25[a]	160 ±1.59	271 ±2.86	360 ±2.93	408 ±2.55
2	16.1 ±0.23[b]	162 ±1.62	275 ±2.61	363 ±2.63	412 ±2.30
P value	< .001	0.580	0.302	0.377	0.193
Hatch					
1	16.9 ±0.32	157 ±2.15[b]	272 ±3.84[ab]	351 ±3.70[b]	406 ±3.07
2	17.0 ±0.28	161 ±2.04[ab]	266 ±3.37[b]	364 ±3.55[a]	410 ±3.07
3	16.5 ±0.27	166 ±1.68[a]	280 ±2.83[a]	368 ±2.88[a]	413 ±2.59
P value	0.502	0.005	0.009	0.001	0.212

BW0: Body weight at first day of age, BW1: Body weight at 7 days of age, BW2: Body weight at 14 days of age, BW3: Body weight at 21 days of age, BW4: and Body weight at 28 days of age. Means having different superscripts letter within each genetic group, generation, and hatch effect in the same column are significantly different at specified P.

Table (3): Least square mean (± standard error) for body weight at sexual maturity of the three breeds.

	Body weight at sexual maturity
Genetic group	
Local Egyptian	287± 7.61[c]
Zagel	406 ±7.40[b]
White Myrthes	497 ±6.29[a]
P value	< 0.001
Generation	
Base population	401 ±5.40
First generation	388 ±6.21
P value	0.713
Sex	
Male	418 ±5.74[a]
Female	372 ±5.80[b]
P value	0.002

Means having different superscripts letter within each genetic group and sex effect in the same column are significantly different at specified P.

Table (4): Least square mean (± standard error) for growth rate % of the three breeds.

	GR1	GR 2	GR 3	GR 4	TGR
Genetic group					
Local Egyptian	163 ±0.83	37.2 ±1.61[c]	30.2 ±1.72	13.1 ±0.84	183 ±0.55[b]
Zagel	163 ±.94	50.7 ±1.25[b]	30 ±0.98	12.5 ±0.45	183 ±0.33[b]
White Myrthes	162 ±0.64	62.0 ±0.81[a]	29.2 ±0.86	12.3 ±0.39	186 ±0.34[a]
P value	0.848	< .001	0.758	0.630	< .001
Generation					
1	162 ±0.66	49.9 ±0.99	30.1 ±1.04	11.9 ±0.50 [b]	183 ±0.35[b]
2	164 ±0.62	50.1 ±0.96	29.5 ±0.85	13.4 ±0.41[a]	185 ±0.30[a]
P value	0. 140	0.854	0.617	0.015	< .001
Hatch					
1	163 ±0.88	53.1 ±1.47[a]	28.4 ±1.36	12.6 ±0.61	183 ±0.42[b]
2	162 ±0.79	47.6 ±1.09[b]	31.7 ±1.06	12.8 ±0.57	184 ±0.40[ab]
3	163 ±0.70	49.2±0.96[ab]	29.3 ±0.99	12.5 ±0.44	185 ±0.36[a]
P value	0.524	0.009	0.092	0.934	0.013

GR1: growth rate % between hatch and 1 week of age; GR2: growth rate % between 1 and 2 weeks, GR3: growth rate between 2 and 3 weeks, GR4: growth rate % between 3 and 4 weeks, and TGR (Total growth rate): growth rate between 0 and 28 days of age. Means having different superscripts letter within each genetic group, generation, and hatch effect in the same column are significantly different at specified P.

Table (5): Estimates of genetic correlations (above the diagonal), phenotypic correlations (below the diagonal) and heritability (on diagonal) for live body weight at different ages

Traits	BW0	BW1	BW2	BW3	BW4
BW0	0.21± 0.08	0.93 ±0.10	0.96 ±0.11	0.83 ±0.12	0.78 ±0.13
BW1	0.66 ±0.04	0.25 ±0.08	0.88 ±0.14	0.98 ±0.09	0.70 ±0.16
BW2	0.54 ±0.05	0.73 ±0.03	0.22 ±0.09	0.73±0.22	NA
BW3	0.64 ±0.04	0.81 ±0.02	0.81 ±0.02	0.24 ±0.09	NA
BW4	0.56 ±0.05	0.74 ±0.03	0.63 ±0.04	0.82 ±0.023	0.26 ±0.09

BW0: Body weight at first day of age, BW1: Body weight at 7 days of age, BW2: Body weight at 14 days of age, BW3: Body weight at 21 days of age, BW4: Body weight at 28 days of age and (NA) not available.

Table (6): Estimates of genetic correlations (above the diagonal), phenotypic correlations (below the diagonal) and heritability (on diagonal) for growth rate.

Traits	GR1	GR2	GR3	GR4	TGR
GR1	0.21±0.08	0.88 ±0.10	0.41 ±0.32	0.39 ±0.34	0.88 ±0.07
GR2	0.74 ±0.03	0.22 ±0.08	0.57 ±0.31	0.51 ±0.33	0.88 ±0.13
GR3	0.44 ±0.06	0.57 ±0.05	0.09 ±0.06	0.20 ±0.6	0.69 ±0.41
GR4	0.37 ±0.07	0.77 ±0.08	0.12 ±0.07	0.18 ±0.09	0.33 ±0.27
TGR	0.91 ±0.01	0.58 ±0.13	0.39 ±0.06	0.12 ±0.07	0.28 ±0.09

GR1: growth rate % between hatch and 1 week of age; GR2: growth rate % between 1 and 2 weeks, GR3: growth rate between 2 and 3 weeks, GR4: growth rate % between 3 and 4 weeks, and TGR (Total growth rate): growth rate between 0 and 28 days of age.

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الملخص العربي

الأداء الإنتاجي لثلاث سلالات من الحمام (Columba livia domestica) تحت الظروف المصرية.

عمر أحمد محمد[1] ، محمد بهى الدين محمد[2] ،إبراهيم محمد كمال أباظه[1] ،جلال صبحى ابو خديجه[1]

[1]كليه الزراعة الصحراوية والبيئية - فوكة - جامعة مطروح – مطروح
[2]كليه الزراعة (الشاطبى) - جامعة الأسكندرية – الأسكندرية

أجريت هذه الدراسة لدراسة أداء النمو لثلاث سلالات من الحمام (الحمام المحلي المصري – الحمام الزاجل – حمام White Myrthes الفرنسى الاصل). تم استخدام عدد 475 طائر من السلالات الثلاث لدراسة وزن الجسم الحي في اعمار الفقس و1 و2 و3 و4 أسابيع بالإضافة الى وزن الجسم عند البلوغ الجنسي ومعدلات النمو بين الفترات (1:0) و (1 :2) و (3:2) و (4:3) و(4:0) أسابيع من العمر. أظهرت نتائج وزن الجسم تفوق الحمام الزاجل والفرنسي بفارق معنوي على الحمام المحلي المصري في الوزن عند عمر الفقس وعمر 7 أيام، ثم تفوقت سلالة الحمام الفرنسي على الحمام الزاجل والحمام المحلي المصري في الاعمار المتأخرة بفروق معنوية وكان الحمام المحلي المصري هو الأقل وزنا في جميع الأعمار. كانت معدلات النمو أعلى في الأسبوع الأول من العمر (162-163 جرام) ثم انخفضت بشكل تدريجي حتى وصلت لأقل معدل في الفترة من 21 إلى 28 يوم. أظهر حمام White Myrthes نموا أسرع خلال فترة النمو كلها من الفقس حتى عمر 4 أسابيع. أظهرت تقديرات المكافئ الوراثي لأوزان الجسم ومعدلات النمو قيما متوسطة، عدا معدل النمو في الأسبوع الثالث. تراوحت تقديرات قيم المكافيء الوراثي من 0.21إلى 0.28 لوزن الجسم وبين 0.09 إلى 0.28 لمعدل النمو. أظهرت تقديرات الارتباطات المظهرية بين أوزان الجسم ومعدلات النمو قيم موجبة ومرتفعة وتراوحت بين 0.63 الى 0.82 وبين 0.12 الى 0.77 على التوالي. وأظهرت النتائج أن قيم الارتباطات الوراثية لاوزان الجسم ومعدلات النمو قيم موجبة تراوحت بين 0.70 الى 0.96 وبين 0.20 الى 0.88 على التوالي . أظهرت نتائج الدراسة الحالية تفوق سلالة الحمام اللاحم الفرنسي في صفات النمو المدروسة مما يعطي الفرصة لإدخاله في برامج مستقبلية للتحسين الوراثي في صفات النمو في الحمام.