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EFFECT OF CROSSING AND SEASONS ON EGG PRODUCTION TRAITS IN TURKEYS

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ABSTRACT: Crossing between two varieties of turkeys (local Black Baladi (BB) and a commercial White Nicholas (WW) was carried out to estimate heterosis, direct additive and maternal effects for egg production traits, in addition to season effect.The breeding plan permitted the simultaneous production of the two pure varieties (BB and WW) and their reciprocal crosses (WB and BW) throughout two successive years from 2006 to 2007. Crossing and season had significant effect on all egg production traits. Genotypes by season's interactions were significant. The crossbred (BW) had better performance than those of the reciprocal cross (WB) for age at 50 % egg production, EN/hen, egg weight, egg mass and feed conversion during summer, autumn and spring seasons of laying. The superiority of BB as sires suggests that the use of this variety as a terminal sire breed in crossbreeding programs including WW dams would be beneficial for improving the former traits.

Key Words: Turkeys, crossing, heterosis, additive, maternal, season.

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INTRODUCTION

Crossing effects (direct additive, direct heterosis and maternal additive) had been used to determine the magnitude value of crossing breeds in improving their performance. Highly estimates of direct additive and maternal effects for native breeds were reported (Nestor, 1971; Zaidan, 1982; Hassan et al., 1985; Nestor et al., 2004; Mohamed et al., 2005; Aly et al., (2005); and Mustafa 2011).

Heterosis caused by non-additive gene effects could decrease through recombination of favorable genes or recombination loss (Dickerson, 1965). Mather and Jinks (1982) reported that the presence of the interaction between sire breed and dam breed indicates the existence of non additive gene effect. Many investigators confirmed the superiority of crossbreds over the purebreds regarding reproductive and some economic traits (Abdou, 1992; Nawar and Abdou, 1999, and Amin, 1999, 2007and 2008).

Significant differences between strains, lines and crossbreds in egg number, egg mass ,egg weight, rate of laying, Feed intake and feed conversion were reported by Gad et al. (1991); Hulet et al. (1992), Nestor and Noble (1995); Nestor et al. (1997); Mustafa and Younis (2001) and Amin (2007, 2008).

Season is one of main environmental factors that affect turkey production. Genotype by Season interaction is usually described as a situation in which different genotypes (breed, lines, or strain) respond differently to different Seasons (Sheridan, 1990).The environmental conditions affecting the performance, health productivity of a turkey include temperature, relative humidity, light and ventilation. High temperature and humidity have some negative effects on poultry such as an increase on poultry body temperature; a decrease on feed consumption and feed efficiency (Howlider and Rose, 1987) and a decrease in productivity and quality of the eggs (Ozbey and Ozcelik, 2004). Reduced turkey performance due to high ambient temperature is well established (Leenstra and Cahaner 1992; Cahaner and Gutman 1993; Eberhart and Washburn 1993).

Seasonal variation was found to have significant effect on egg production traits (Saleh et al, 1991; Zaky 2005 and Younis and Abd El-Ghany, 2003) as well as egg mass and egg Weight (Mohapatra et al, 1986 and Balat, 1990).

The main objectives of the present study were to study the effect of crossing between two varieties of turkeys (Black Baladi and a commercial White Nicholas, and season on egg production traits, and to estimate heterosis, direct additive and maternal effects of these traits .

MATERIALS AND METHODS

The present study was carried out at the Maryout Research Station, Desert Research Center, Ministry of Agriculture, throughout two successive years from 2006 to 2007. Monthly fluctuations of the min, max, means of temperature and relative humidity (RH) during the experimental period were estimated. Means of temperature and RH of seasons (summer, autumn, winter and spring) were also estimated (Tables 1 and 2).

The turkey stock consisted of the local Black Baladi (BB) variety which was introduced to the station from El-Minea Government (Amin, 1999), and commercial White Nicholas (WW) variety. The breeding plan permitted the simultaneous production of the two pure varieties (BB and WW) and their reciprocal crosses (WB and BW). Artificial insemination was used. One male was mated to 5 females biweekly. The pure varieties and reciprocal crosses offspring were obtained in one hatched. At hatching, poults were pedigreed, wing banded and reared on litter floor pens until 52 weeks of age. The hens were given stimulatory lighting of 16 h per day with intensity 51

LX at 39 weeks of age. Poults were fed a starter ration contained 28 % crude protein and 2860 kcal ME/kg until 8 weeks of age. After that, birds received a growing ration contained 22% crude protein and 2950 Kcal ME/kg. At 20 weeks of age, a laying ration contained 15.5 % crude protein and 2920 Kcal ME/kg were given (All the egg production period). Feed and water were supplied ad libitum. Pullets were vaccinated according to a vaccination program recommended by the Maryout Research Station in floor brooders. The birds were sexed and housed in pens at 20 weeks of age .Hens of both varieties and their crosses were divided at random into four groups. Each group is composed of seven pens and all pens containing five pullets. Feed consumption by pen was recorded monthly. Egg production was recorded daily starting from sexual maturity (50% egg production) up to 53 weeks of age. Age and body weight at sexual maturity were estimated in days from hatching up to the day at which each breeding pen reached 50% of egg production. Egg mass was calculated by multiplying the number of eggs per pullet by the mean egg weight in gram.

Statistical analysis:

Statistical analysis was performed using SAS program (SAS, 1992). Data of body weight were analyzed using the following linear model.

$Y_{ijk} = \mu + G_i + S_j + (GS)_{ij} + e_{ijk}$

Where

Y_{ijk} = the observed value of the ijkth poults

μ = the overall mean,

G_i = the effect of the ith genotype,

S_j = the effect of the jth sex,

GS_{ij} = the effect of the interaction between genotype and sex ,

e_{ijk} = the effect of random error.

Data of the other traits were analyzed using the following linear model:

$Y_{ijk} = \mu + G_i + X_j + (GX)_{ij} + e_{ijk}$

Where:

Y_{ijk} = the observed value of the ijkth pullet.

μ = the overall mean,

G_i = the effect of the ith genotype,

X_j = the effect of the jth season,

GX_{ij} = the effect of the interaction between genotype and season,

e_{ijk} = the effect of random error.

Heterosis percentages were estimated according to Dickerson's methodology (Dickerson 1992) as Follows:

$$(H\ \%) = \{[(W \times B + B \times W) - (WW + BB)] / (W + B)\} \times 100$$

Maternal additive effect (i.e. line group of sire differences):

$$G^m_{WW} - G^m_{BB} = [(B\times W) - (W\times B)]$$

Direct additive effect (i.e. line group of sire differences):

$$G^i_{WW} - G^i_{BB} = [(B\times B) + (B\times W)] - [(W\times W) + (W\times B)]$$

RESULTS AND DISCUSSION

Monthly fluctuations of the min, max, means of temperature and RH during the experimental period are presented in Tables (1 & 2), and Fig. (1 & 2).High difference between max and min temperatures was observed during May (15 °C), but the low difference was found in December (9°C.). The RH averaged between 46% and 62 % during the experimental period.

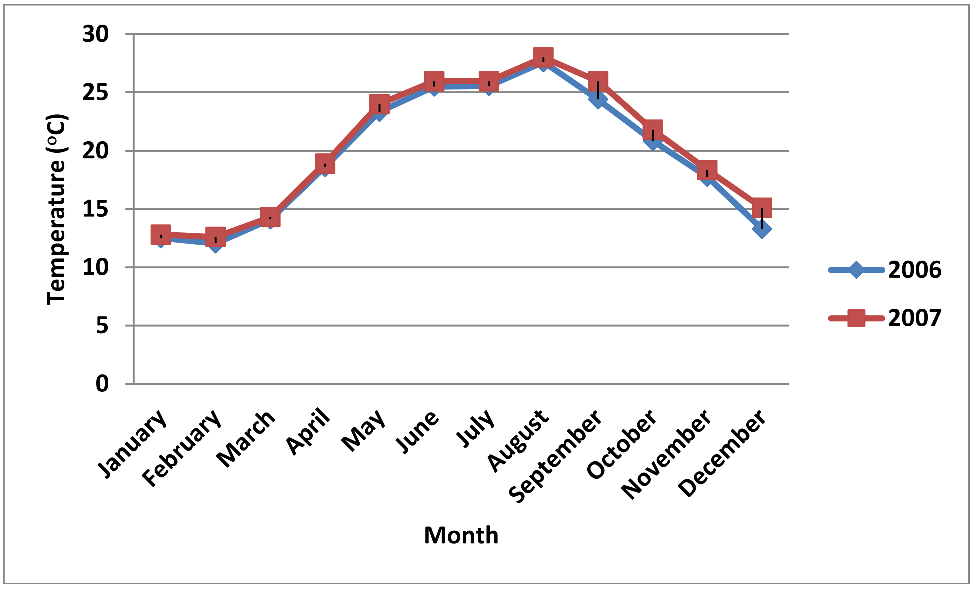
The difference in temperature between summer and winter seasons increased to 13.19°C. High difference was observed between summer and winter seasons, but the low difference was found between summer season and others seasons. They were about 3.5°C and 4.73°C for spring and autumn seasons, respectively. The RH averaged between 49.33% and 60.9% during the experimental period. Similar results were obtained by Zaky (2005), who reported that, the difference in temperature between summer and winter seasons increased to 15 °C.

Table (1): Meteorological data of Maryout Research Station: Minimum (min), maximum (max), means of temperature and relative humidity (RH) by year and month.

Year / Month	2006				2007			
	Temperature			RH	Temperature			RH
	min	max	Mean		min	max	Mean	
January	7.5	17.5	12.5	63	7.6	18	12.8	62
February	7.1	17.0	12.05	66.5	8	17.2	12.6	65.9
March	9.1	19.5	14.1	53	8.5	20.1	14.3	55
April	11.7	25.5	18.6	48	11.9	25.9	18.9	49
May	15.2	31.5	23.35	49	16	32	24	49.5
June	19.5	31.5	25.5	50	19.8	32.1	25.95	50.5
July	16.4	34.7	25.55	51	17	34.9	25.95	53
August	21.3	33.9	27.6	55.5	21.9	35	28	56.2
September	18.1	31.5	24.4	57.5	18.9	33	25.95	57.1
October	15.4	26.3	20.85	56	15.6	28	21.8	55.1
November	12.3	23.2	17.75	63.5	12.8	23.9	18.35	61.2
December	9.1	19.5	13.3	60.1	10.1	20.1	15.1	62.3

Table (2): Means of temperature and Relative humidity (RH) by season.

Seasons	Summer	autumn	Winter	Spring
average temp	26.24	21.51	13.05	22.71
average (RH)	55.05	58.40	60.90	49.33



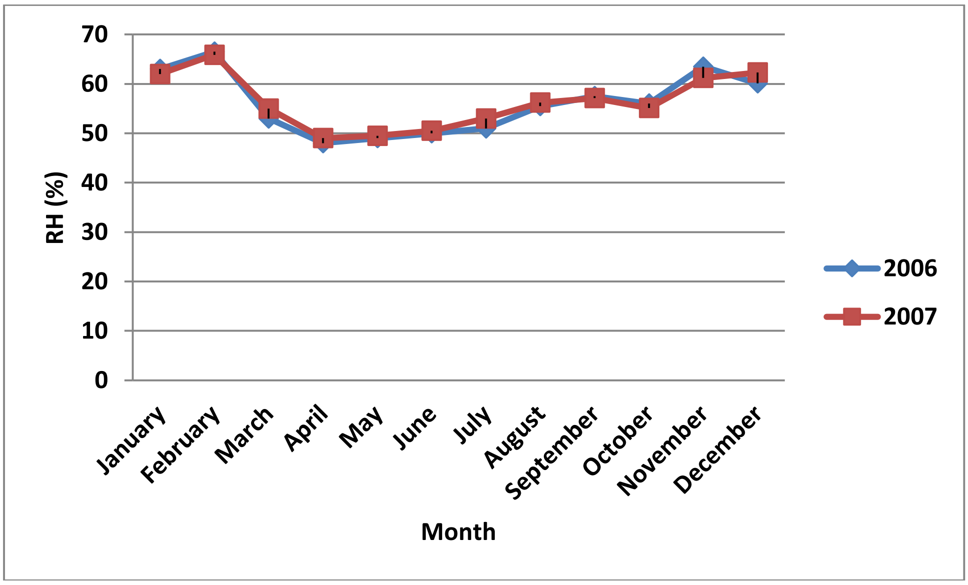
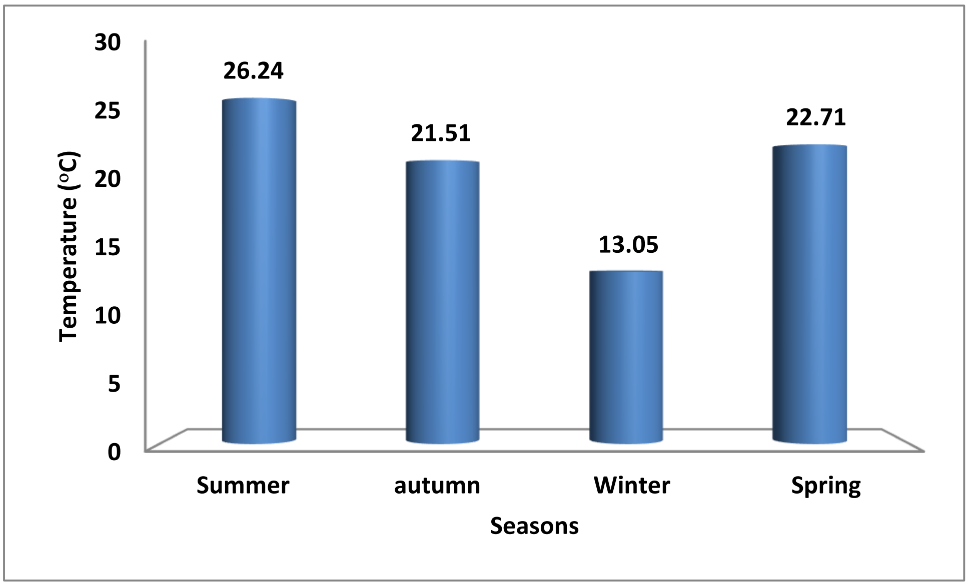


Fig. (1): means of temperature and relative humidity (RH) by year and month



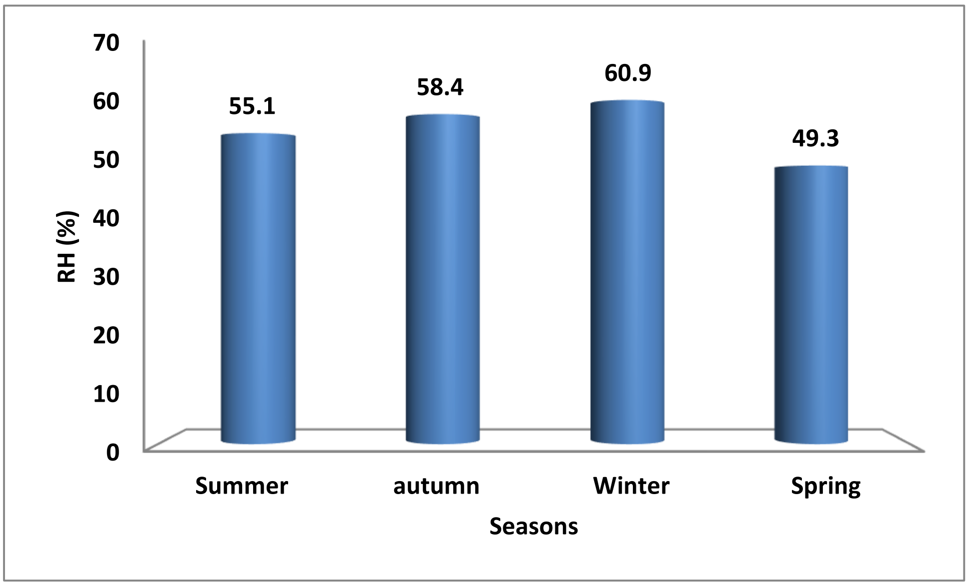


Fig. (2): Means of temperature and Relative humidity (RH) by season

1- Body Weight (BWM) and Age (ASM) at 50 % egg production

Means and standard errors of body weight (BWM), and age (ASM) at 50 % egg production, heterosis(%), maternal additive effect and direct additive effect for the local Black Baladi (BB and White Nicholas (WW) turkey varieties and their reciprocal crosses are presented in Tables 3 and 4.BWM of the purebred genotype (WW) was significantly higher than the other genotypes, which it was heavier more than three times the purebred genotype (BB) in males (16960 vs. 4513.4 g) and females (9045 vs. 2935.6 g). BWM of both crossbred genotypes (WB and BW) were nearly double those of the BB (177.29 % and 210 % respectively) in males. In addition, the crossbred genotype (WB) was significantly heavier than the reciprocal genotype (BW) in males (9488.4 vs. 8001.7 g) and females (5199.2 vs. 4145.8 g). Sex had significant effect on BWM. Males were significantly heavier than females for all genotypes. The overall mean of BWM for males was nearly double that of females (9741.7 vs. 5331.7 g). These results agreed with those reported by Abaza (1983), Amin (1999, 2007 and2008) and Nestor et al. (2004).They reported significant differences among the reciprocal crosses and purebred lines in body weight at different ages in turkeys. Contrary, Kosba et al. (1981), Zatter (1994), Mohamed (2003), Amin (2007) and Mustafa (2011) reported that crossbreeding did not improve body weight at sexual maturity.

Regarding ASM, the crossbred genotypes (BW and WB) significantly matured sexually earlier than the purebred (WW), and later than the other purebred (BB). In addition, the crossbred (BW) significantly matured sexually earlier than the reciprocal crossbred (BW) (294.3 vs. 306.8 d). Moreover, the purebred (BB) significantly matured sexually earlier than the other purebred (WW) (281.6 vs. 339.3 d).

Negative heterosis percentages were observed for BWM in males and females (-18.55 and -22.50 %, respectively).In addition, Negative heterosis (%) was observed for ASM (-3.19 %). Nester et al. (2004) reported that reciprocal effects were an important source of variation of body weight at 50 % egg production. In this respect, Mustafa (2011) reported negative estimates of heterosis for BWM and ASM (-14.34 and -0.53, respectively) with no significant differential. On the other hand, Abou El-Ghar et.al. (2007) and Mekky et.al. (2008) found a positive estimate of heterosis for Matrouh as a common sire parent with Inshas, Mandarah and Silver Montazah as appendage dame parents.

As for maternal additive effect, the values were -1053.4 g and -12.5 d for BWM and ASM, respectively for Females. These values showed that the offspring of the crossbred genotype (BW) had better performance than those of the reciprocal crossbred (WB) for ASM.

While the values for direct additive effect were-7162.5 g and -70.2 d for BWM and ASM, respectively for Females. These values of direct additive effect indicated that using WW toms was better than BB toms for BWM in males and females. In contrast, using BB toms was better than WW toms for ASM. Mustafa (2011) found estimates of direct additive equal to 101.5 g and 1.18 d for BWM and ASM, respectively. The corresponding values for direct maternal genetic effect were -39.19 g and 1.1 d for BWM and ASM, respectively.

Table (3): Means± SE for body weight at 50 % egg production (BWM) and age at 50 % egg production (ASM) for the (BB), (WW) turkey varieties and their crosses.

Traits	Genotype					
	Sex	BB	BW	WB	WW	Overall
Body weight at 50% egg production	M	4513.4 ^{f}±12.9	8001.7 ^{d}±44.1	9488.4 ^{b}±15.7	16960 ^{a}±76	9741. 7±35.2
(BMW), g	F	2935.9 ^{h}±8.63	4145.8 ^{g}±53.5	5199.2 ^{e}±71.6	9045 ^{c}±28	5331.7 ±40.4
Overall		3724.6 ^{D}±8.6	6073 ^{C}±48.8	7374.8 ^{B}±41.7	13003 ^{A}±51.2	
Age at 50 % egg production (ASM), d	F	281.6 ^{d}±1.20	294.3 ^{c}±0.91	306.8 ^{b}±1.84	339.3 ^{a}±0.93	

a–h= Means with different letters are significant (P≤0.05).
A–D = Means with different letters are significant (p≤0.05).

Table (4): Heterosis(%), maternal additive effect and, direct additive effect, for body weight at 50 % egg production (BWM) and age at 50 % egg production (ASM) for the (BB) and (WW) turkey varieties and their crosses.

Item	Trait		
	body weight at 50 % egg production (BWM), g		Age at 50 % egg production (ASM), d
	Male	Female	
Heterosis %	-18.55	-22.50	-3.19
Maternal additive effect	-1486.7	-1053.4	-12.5
Direct additive effect	-13933.3	-7162.5	-70.2

2- Egg Number (EN)

Pullets of BB genotype laid significantly highest number of eggs (90.4egg) during the whole period (Table 5), compared to the other genotypes. Egg number (EN) of both genotypes (WW and BW) was approximately equal (60.8 and 60.2 egg), while using WW as a sire, egg number decreased significantly to 50.2 egg for the genotype (WB).

These results agreed to those reported by (Nestor, 1971; Stasko and Soulic, 1974; Zaidan, 1982; Hassan et al., 1982; and Nestor et al., 2004).They reported that genotypes of turkey were significantly differed in EN. Moreover, Black Baladi (BB) was the best genotype in egg production as observed by Amin (1999). He reported that during the 84-d production, the BB pullets laid significantly more egg than WW by 13 eggs (44%). In addition, Amin (2007) found that BB variety recorded EN at 32-44 wks of age for the three years which studied to be 25, 29 and 37 eggs.

Season had significant effect on EN. In addition, the interaction between genotypes and seasons was statistically significant for EN. While pullets of BB produced the highest EN at the summer season of production (37.4 egg), the other genotypes (WW, BW, WB) laid the highest EN throughout the winter season of lay (29.4, 27.3, 22.5 egg, respectively). The high production of eggs for the BB in summer may be due to that this variety is a local strain, and lives in high temperate, where most of the farms turkey in Egypt are in Upper Egypt. On the other hand WW turkey is a foreign strain and come from a cold environment, therefore, EN increased in winter season for WW compared to BB.

Similar results were reported by Younis and Abd El-Ghany (2003).They found that EN declined by about 10% during summer season (49.44egg) compared with winter season (55egg).

Heterosis estimate of EN was negative (-26.9 %). This result indicates the superiority of purebred genotypes (BB, WW) compared to their crossbreds (BW, WB) in EN. Early report for egg production in turkey found negative heterosis (Nestor, 1997), while Nestor et al. (2004) reported positive heterosis for EN based on 84, 120 and 180-d and for rate of lay based on data for a 180-d production. Moreover, Emmersonet al. (1991) found that heterosis of egg production was 23% for 84-d and 37.9% for 180-d egg production. In contrary, no heterosis was observed for egg production when measured for 84,180 or 250 d (Emmersonet al., 2002).

The values of maternal additive effect (10 eggs) and direct additive effect (39.6 eggs) of EN showed that using WW hens as a dam with BB toms as a sire give an advantage for this trait. These results lead to confirm that dams of WW variety are better concerning their mothering ability versus strains. The superiority of BB as sires suggest that the use of this variety as a terminal sire breed in crossbreeding programs including WW dams would be beneficial for improving egg number. Mustafa (2011) found negative direct additive effect for EN_{90}which indicated that egg line was better as a sire than the meat line for this trait. On the other hand, Ghanem et al., (2008) found no additive genetic effects have their impact on egg production traits. However, highly significant and positively effect for EN_{90} trait indicated that egg line was better as Sharma et al (1992) who observed an evidence for the significant maternal effects for egg production traits, while Khalil et al. (2004) reported that the percentage of maternal additive effect was negative estimate (-16.6%) for first three-month egg production.

Table (5): Means± SE for egg number (egg/hen) (EN) by season, heterosis (%), maternal additive effect and direct additive effect for the (BB), (WW) turkey varieties and their crosses.

Genotype	Season				Overall
	Summer	Autumn	Winter	Spring	
BB	37.4±2.2 [a]	12.2±1.3[d]	15.50±3.3 [cd]	25.30±2.7 [b]	90.4±6.2 [A]
BW	6.50±1.8[e]	5.70±0.5 [e]	27.30±0.5 [b]	20.70±1.6 [c]	60.2±4.5 [B]
WB	4.70±1.5[e]	5.70±0.9 [e]	22.50±2.2[bc]	17.30±2.3 [e]	50.2±3.9 [C]
WW	7.40±2.2[g]	6.50±0.8[f]	29.40±1.9 [b]	17.50±1.3[c]	60.8±3.1 [B]
Overall	56.0±5.1γ	30.1±2.9δ	94.7±6.3α	80.8±5.9β	
Heterosis (%)					-26.9
Maternal additive effect, egg					10.0
Direct additive effect, egg					39.6

a – g: Different letters between pure strains, crosses and reciprocal crosses are significant (P<0.05).
A–C: Different letters between overall means of genotypes are significant (p<0.05).
α - δ: Different letters between overall means of seasons are significant (p<0.05).

3- Egg Mass (EM)

Genotypes had significant effect on egg mass (EM). The pure BB variety had significantly the highest value of EM (7478.6 g). While WB crossbred had the lowest EM (4524.4 g) (Table 6). No significant difference was observed between BW cross and the pure WW genotype, which had intermediate means of EM (5428.5 and 5561.5g), respectively throughout the whole period studied. Similar results were reported by Amin (1999). He stated that BB turkey during 84-d of egg production period surpassed WW turkey in EM by approximately 0.6kg (25%) per pullet. In addition, several authors found significant differences between genotypes concerning egg mass (Nestor, 1971; zaidan, 1982, Hassan et al., 1985; Nestor, 1997 and Harvenstein et al., 2007).

Statistically significant differences were observed between seasons for EM. The highest EM was in winter (8581.0 g), followed by spring (7463.9 g), then summer (4545.8 g), while autumn was the lowest in EM (2402.3 g). The interaction between genotypes and seasons was statistically significant. The pure BB genotype had significantly the highest values of EM in the summer, autumn and spring seasons (2999.5, 950.4 and 2211.2 g), respectively, while the WW genotype had the highest mean of EM in winter (2723.6 g).The WW turkey is a foreign strain and come from a cold environment, therefore, EM increased in winter season for WW compared to BB.

Statistically significant difference was reported between seasons, winter exceeded summer in egg mass by about 11.12% (Younis and Abd El-Ghany, 2003)

Heterosis estimate of EM was negative (-23.7 %). This result indicates the superiority of purebred genotypes (BB, WW) compared to their crossbreds (BW, WB) in EM.

The values of maternal additive effect (904.1 g) and direct additive effect (2821.2 g) of EM showed that using WW hens as a dam with BB toms as a sire gives an advantage for this trait. These results lead to confirm that dams of WW variety are better concerning their mothering ability versus strains. The superiority of BB as sires suggest that the use of this variety as a terminal sire breed in crossbreeding programs including WW dams would be beneficial for improving egg mass.

Table (6): Means± SE for egg mass (g/hen) (EM) by season, heterosis (%), maternal additive effect and direct additive effect for the (BB), (WW) turkey varieties and their crosses.

Genotype	Seasons				Overall
	Summer	**Autumn**	**Winter**	**Spring**	
BB	2999.5±253 ^{a}	950.400±11.1^{g}	1317.5±243^{f}	2211.2±251^{d}	7478.6±320 ^{A}
B W	521.10±210^{hl}	457.10±10.10 ^{l}	2487.9±104^{c}	1962.4±763 ^{d}	5428.5±201 ^{B}
WB	385.10±40.5 ^{l}	445.500±20.2 ^{l}	2052.0±215 ^{d}	1641.8±206^{e}	4524.4±190 ^{C}
W W	640.10±78 ^{h}	549.30±30.2 ^{h}	2723.6±374 $^{b\ c}$	1648.5±172 ^{e}	5561.5±220 ^{B}
Overall	4545.8 ±199$^{\beta}$	2402.3±41.2$^{\gamma}$	8581.0±210$^{\alpha}$	7463.9±75.21$^{\alpha}$	
Heterosis(%)					-23.7
Maternal additive effect					904.1
Direct additive effect					2821.2

a–l: Different letters between pure strains, crosses and reciprocal crosses are significant (P<0.05).

A–C: Different letters between overall means of genotypes are significant (p<0.05).

α- γ: Different letters between overall means of seasons are significant (p<0.05)

4- Egg Weight (EW),:

Genotype had significant effect on egg weight (Table 7). The purebred genotype (WW) and the crossbred (WB) and its reciprocal (BW) laid the heaviest egg (89.5, 86.6, 86.6 g), respectively. While the purebred genotype (BB) laid the lightest eggs (82.6 g).
There were significant differences between seasons in EW. Winter and spring seasons were the highest in EW, while autumn and winter were the lowest in EW (Table 7).

The interaction between genotypes and seasons for EW was statistically significant. Eggs produced from WW pullets, crossbred (WB) and reciprocal crossbred (BW) were significantly the heaviest during the winter and spring seasons and ranged between 91.1 to 94.9 g, while pullets of BB had significantly the lowest EW (85.0 and 87.4 g), respectively, compared to those produced from pullets of the other genotypes and season. Generally, both the reciprocal crosses had intermediate means of egg weight throughout the whole period studied. Godwin et al. (2005) reported that egg weight ranged between 79.2 to 94.3 g for hybrid EURO FP line of turkey. Similar results were obtained by Younis and Abd El-Ghany (2003) who found significant difference between seasons, where the eggs produced during winter were heavier (54.0g) than summer (51.0 g) in chicken. The effect of crossbreeding on egg production traits has been studied by many investigators (Nestor, 1971; zaidan, 1982, Hassan et al., 1985; Nestor, 1997, Harvenstein, et al, 2007 and Amin 1999, 2007 and 2008).

Heterosis estimate of egg weight was positive (0.63 %). The value of maternal additive effect was positive. The direct additive effect was negative. Generally, using White Nicholas (WW) turkeys as a dam breed with Black Baladi (BB) toms as a sire breed gives an advantage for egg weight (Amin 1999, 2007 and 2008).

Table (7): Means± SE for egg weight (g) (EW) by season, heterosis (%), maternal additive effect and direct additive effect for the (BB), (WW) turkey varieties and their crosses.

Genotype	Seasons				Overall
	Summer	Autumn	Winter	Spring	
BB	80.2±1.7 ^{b}	77.9±1.6^{bc}	85.0±1.8 ^{b}	87.4±1.2 ^{b}	82.6±1.6 ^{B}
BW	80.3±0.9 ^{b}	80.2±4.8^{b}	91.1±0.5 ^{a}	94.8±0.1 ^{a}	86.6±1.1 ^{AB}
WB	82.1±1.0 ^{b}	78.2±0.8^{bc}	91.2±1.6 ^{a}	94.9±0.3 ^{a}	86.6±1.3 ^{AB}
WW	86.5±0.9^{b}	84.5±0.7 ^{c}	92.6±0.8 ^{a}	94.2±1.8 ^{a}	89.5±0.9 ^{A}
Overall	82.3±4.1$^{\beta}$	80.2±1.5$^{\beta}$	90.0±1.2$^{\alpha}$	92.8±0.9$^{\alpha}$	
Heterosis(%)					0.63
Maternal additive effect, g					0.01
Direct additive effect, g					-6.89

a–c: Different letters between pure strains, crosses and reciprocal crosses are significant (P<0.05).
A–B: Different letters between overall means of genotypes are significant (p<0.05).
α-β: Different letters between overall means of seasons are significant (p<0.05).

5- Rate of Laying % (RL):

Pullets of BB genotype had significantly highest RL (25%) during the whole period (Table 8), compared to the other genotypes. Rate of laying (RL) of both genotypes (WW and BW) was equal (16 %), while using WW as a sire, RL decreased significantly to 13 % for the genotype (WB).

Season had significant effect on RL. In addition, the interaction between genotypes and seasons was statistically significant for RL. Estimates of the rate of laying (RL) had the same trend which observed in EN of the different seasons studied (Table 8).

Heterosis (%) of RL was negative (-29.27 %). The values of maternal additive effect and direct additive effect of RL showed that using WW a hen as a dam with BB toms as a sire gives an advantage for this trait.

Table (8): Means ±SE for rate of lying % (RL)by seasons, heterosis (%), maternal additive effect and direct additive effect for the (BB), (WW) turkey varieties and their crosses.

Genotype	seasons				Overall
	Summer	Autumn	Winter	Spring	
BB	41±4.0 ^{a}	13±0.02 ^{d}	17±1.1 ^{d}	28±3. 00^{b}	25±4.1 ^{A}
BW	07±0.1 ^{e}	06±0.001^{e}	30±1. 9 ^{b}	23±2.00^{bc}	16±0.9 ^{B}
WB	05±0.3 ^{e}	06±0.002 ^{e}	25±2.3 ^{b}	19±2.22$^{c\,d}$	13±1.0 ^{C}
WW	08±0.1 ^{e}	07±0.005^{e}	32±3.3^{b}	19±0.9 $^{c\,d}$	16±2.0 ^{B}
Overall	15.3±0.1$^{\beta}$	08±0.5$^{\beta}$	26±0.39$^{\alpha}$	22.3±1.0$^{\alpha}$	
Heterosis(%)					-29.27
Maternal additive effect					3
Direct additive effect					12

a–e: Different letters between pure strains, crosses and reciprocal crosses are significant (P<0.05).

A–C: Different letters between overall means of genotypes are significant (p<0.05).

α-β: Different letters between overall means of seasons are significant (p<0.05)

6- Feed Intake (g /hen) (FI), (g / eggs) and Feed Conversation (FC)

Significant differences were observed concerning feed intake (FI) (Table 9). The WW pullets consumed more amount of ration compared to the pullets of the other three genotypes. The FI of WW at the four subsequent seasons studied were 22087g /hen, 23006g /hen, 24015g /hen and 23587g/hen, respectively, and at the whole period studied, FI was 92695 g/hen, While BB pullets consumed about half of this amount throughout the same period (50174g). Pullets of both the BW and WB crosses consumed nearly equal amounts of ration (68205 and 68342 g), respectively.

Differences were found between genotypes with respect FI per egg (Table 10).The same trend was observed for the all seasons studied except that of the winter season, where no significant differences were observed. Generally, FI per egg for the pure WW and the reciprocal crosses were approximately three times that consumed by the BB pullets (675.7g) throughout the whole period studied.

Higher ambient temperature during summer caused a reduction in feed consumption in order to reduce heat production and keep the body temperature within normal range. Similar results were obtained by Henken et al. (1982) and Saleh et al. (1991).

Heterosis (%) for FI per pullet was negative. While it was positive for FI per egg.

Concerning feed conversion (FC), significant differences were found among the four genotypes. Wide range was found throughout the different seasons where BB pullets had the best feed conversion, where the means of the summer, autumn, winter and spring seasons were 3.80, 13.15, 10.16 and 5.81, respectively, with overall mean for the whole period equal to 8.23. The FC of WW pullets was the highest (25.62), while those for BW and WB were 22.12 and 26.20, respectively. The superiority of FC for the BB pullets may be related to the little amount of ration which consumed and it is surpassed the other genotypes in egg production. Younis and Abd El-Ghany (2003) reported that FC was affected by season. Itwas4.27 in summer vs. 3.83 in winter.

Heterosis % was positive for FC. Differences between several genotypes with respect of FI were reported by Zaidan (1982) and Nestor (1997). Amin (1999) found that during 84 –d of production, Black Baladi turkey consumed significantly less feed and utilized efficiently the feed for egg production more than the White Nicholas, where the daily FI of BB was less than WN by about 46 % (150.46 vs. 277.24 g/hen) and FC was (4.8 vs. 11.84).using Hybrid EIIRO FP of turkey, Goduin et al. (2005) found that feed intake (g/bird/day) was 308 g at 14 wk of lay.

In conclusion, using (WW) genotype as a dam breed with (BB) toms as a sire breed gives an advantage for body weight and age at 50 % egg production, EN/hen housed, egg mass, egg weight, and feed conversion. These results lead to confirm that dams of WW genotype are better concerning their mothering ability versus varieties. In addition, the superiority of BB as sires suggest that the use of this variety as a terminal sire breed in crossbreeding programs including WW dams would be beneficial for improving the former traits.

Table (9): Means± SE for Feed intake (g/hen) (FI) by seasons, heterosis (%), maternal additive effect and direct additive effect for the (BB), (WW) turkey varieties and their crosses.

Genotype	Seasons				Overall
	Summer	Autumn	Winter	Spring	
BB	11412±265 ^{c}	12500±620 ^{c}	13392.5±298 ^{bc}	12870±180 ^{c}	50174±363.0 ^{C}
BW	15063±162 ^{b}	20500±817 ^{ab}	16500±168 ^{b}	16142±140 ^{b}	68205±321.7 ^{B}
WB	14587±580 ^{b}	21475±170 ^{a}	16440±597 ^{b}	15840±540 ^{b}	68342±471.0 ^{B}
WW	22087±404 ^{a}	23006±1974 ^{a}	24015±465 ^{a}	23587±430 ^{a}	92695±818.3 ^{A}
Overall	15787.3±352 $^{\gamma}$	19370.3±295 $^{\alpha}$	17586.9±382 $^{\beta}$	17109.8±322 $^{\beta}$	
Heterosis(%)					-4.418
Maternal additive effect					-135
Direct additive effect					-42647

a–c: Different letters between pure strains, crosses and reciprocal crosses are significant ($P<0.05$).

A–C: Different letters between overall means of genotypes are significant ($p<0.05$).

α-γ: Different letters between overalls means of seasons are significant ($p<0.05$)

Table (10): Means± SE for Feed intake (g/eggs) by seasons, heterosis (%), maternal additive effect and direct additive effect for the (BB), (WW) turkey varieties and their crosses.

Genotype	Seasons				Overall
	Summer	Autumn	Winter	Spring	
BB	305.3±07.0 [e]	1024.6±50.1 [c]	864.0±19.27 [d]	508.9±7.100 [e]	675.7±20.86 [C]
BW	2317.2±104 [b]	3596.5±0142 [a]	804.4±6.110 [d]	800.8±18.11 [d]	1879.7±67.6 [B]
WB	3103.7±123 [a]	3767.54±400 [a]	822.9±17.40 [d]	915.6±31.20 [d]	2152.4±142 [A]
WW	2984.0±054 [a]	816.8±15.800 [d]	816.8±15.80 [d]	1347.8±24.6 [c]	2172.0±99.6 [A]
Overall	2176.6±72.1 [β]	2982.1±88 [α]	827.2±14.6 [γ]	893.3±20.3 [γ]	
Heterosis(%)					41.59
Maternal additive effect					-272.7
Direct additive effect					-1769

a–e: Different letters between pure strains, crosses and reciprocal crosses are significant ($P<0.05$).

A–C: Different letters between overall means of genotypes are significant ($p<0.05$).

α-γ: Different letters between overall means of seasons are significant ($p<0.05$)

Table (11): Means± SE for feed conversation (g feed/ g egg) by seasons, heterosis (%), maternal additive effect and direct additive effect for the (BB), (WW) turkey varieties and their crosses.

Genotype	Seasons				Overall
	Summer	**Autumn**	**Winter**	**Spring**	
BB	3.80±0.27 ^{a}	13.15±0.65 ^{b}	10.16±0.22 ^{b}	5.81±0.20 ^{a}	8.23±0.33 ^{A}
BW	28.8±0.30^{d}	44.84±1.78^{f}	6.63±0.23 $^{a\,b}$	8.22±0.26 ^{b}	22.12±0.64 ^{B}
WB	37.80±1.5^{e}	48.2±5.11 ^{f}	9.26±0.28 ^{b}	9.64±0.32 ^{b}	26.2±1.80 ^{C}
WW	34.50±0.65^{e}	41.88±3.6^{e}	8.81±0.17 ^{b}	17.31±0.26 ^{c}	25.62±1.2 ^{C}
Overall	26.2±0.7$^{\beta}$	37.01±2.8$^{\alpha}$	8.8±0.3$^{\gamma}$	10.3±0.3$^{\gamma}$	
Heterosis(%)					42.75
Maternal additive effect					-4.08
Direct additive effect					-21.47

a–f: Different letters between pure strains, crosses and reciprocal crosses are significant (P<0.05).

A–C: Different letters between overall means of genotypes are significant (p<0.05).

α-γ : Different letters between overall means of seasons are significant (p<0.05)

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الملخص العربى

تأثير الخلط و الموسم على صفات إنتاج البيض فى الرومى

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تم الخلط بين صنفين من الرومى (البلدى الأسود BB و النيوكلاس الأبيض التجارى WW) وتم قياس قوة الهجين ، التاثير الأموى و الأبوى لصفات إنتاج البيض بألاضافة الى تأثير الموسم. خطة التربية أعتمدت على قياس الأنتاج للصنفين النقيين(BB وWW) والخليط (BW) والخليط العكسى(WB) خلال عامين متتاليين ٢٠٠٦-٢٠٠٧ . الخلط والموسم كان لة تأثير معنوى على كل صفات إنتاج البيض. التفاعل بين التركيب الوراثى و الموسم كان لة تأثير معنوى .كان الخليط (BW) أفضل فى الأداء من الخليط العكسى (WB) فى صفات العمر عند ٥٠% إنتاج ، إنتاج البيض/ دجاجة ، وزن البيض ،كتلة البيض والكفائة الغذائية خلال مواسم انتاج البيض الصيف ،الخريف و الربيع . تفوق الرومى الأسود بأعتبارة ذكر لذلك يمكن أستخدامة فى برنامج خلط يشمل النيوكلس الأبيض كأم يكون مفيد فى تحسين الصفات السابقة.