

MINISTRY OF EDUCATION AND TRAINING    MINISTRY OF AGRICULTURE AND  
RURAL DEVELOPMENT  
**NATIONAL INSTITUTE OF ANIMAL SCIENCE**

TRAN NGOC TIEN

**CREATING FOUR GRANDPARENTAL EGG  
PRODUCTION CHICKEN LINES  
GT1, GT2, GT3 AND GT4**

**Major:** Heritability and creating animals

**Code number:** 962.01.08

**DOCTORAL THESIS SUMMARY**

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**Supervisors:**

1. Assoc. Prof. Dr. Nguyen Huy Dat
2. Dr. Nguyen Quy Khiêm

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3. Library of the Thuy phuong poultry research center

## INTRODUCTION

### **The necessary of research problem**

HA1 and HA2 chicken lines are created from Egypt and Hyline chicken resources, given egg production 235-239 eggs per hen, consume food 1.9-2.05kg, good egg quality, yolk ratio 31-32%. The above chicken lines promoted the excel in egg quality and cover colors which suited to consumers' demand. However, the production of eggs has been still lower than egg chicken production lines over the world.

In 2012, Thuy Phuong Poultry Research Center had imported egg chicken production lines from BASBOLNA TETRA-SL Ltd of Hungary: Grandparent chickens' egg production per a hen per 72 weeks reach 275-285 eggs, egg weight was 59.50-50.50g, the egg productivity of parental chickens per a hen over eighty weeks old was 365 eggs, the average of an egg was 62.0g (*according to BĂBOLNA TETRA-SL, 2012*). Although this chicken line is high egg production, the egg quality is limited as the ratio of yolk is low with 26-28%, the color of cover is dark brown which is not suitable to consumers in the country.

To meet the need of people about high egg production and good egg quality, it is necessary to research creating new egg production chicken, promotes the excel in high egg production of domestic imported egg production chicken and good egg quality of present chicken line, creates high egg production chicken of Vietnam and consists of four chicken lines. Therefore, we create high egg parental chickens to meet the demands and produce the commercial chicken lines with high egg production which do not belong to the importation from abroad. Hence, carrying out the thesis "*Creating four grandparental egg production chicken lines GT1, GT2, GT3, GT4*" from Tetra-SL and HA1, HA2 chicken lines is necessary

### **THE PURPOSE OF THE THESIS**

#### **The general purpose**

Creating four grandparental egg production chicken lines GT1, GT2, GT3, GT4 from HA1, HA2 imported resources and Tetra-SL domestic chicken line.

#### **The specific purposes**

Creating four grandparental egg production chicken lines: GT1 chicken line with egg production over sixty-eight weeks old from 245 to

250 eggs; GT2 chicken line is from 240 to 245 eggs; GT3 chicken line is from 240 to 245 eggs; and GT4 chicken line is from 310 to 320 eggs.

From four grandparental lines creating two parental chickens with egg production per a hen over sixty-eight weeks old reached 260-265 eggs and commercial hybrid chicken with egg production per a hen over eighty weeks old reached 310-320 eggs.

## **THE SCIENCE AND PRACTICE MEANING OF THE THESIS**

### **The science meaning**

- This is the first science research about creating four grandparental egg chicken lines which have production and quality egg to meet the need of egg production.

- Completing the method in creating domestic chicken lines in Vietnam's condition.

- The results of the research are the science document resources that are valuable in research and education.

### **The practice meaning**

The results of the thesis have great meaning to production as we created egg chicken line to meet the demand of egg production.

### **The new owned results of the thesis**

This is the first science research about creating grandparental egg production chicken lines from egg production domestic grandparent chickens and egg production chickens in the country to create new egg production chicken lines with high production and good quality which are suitable to Viet Nam consumers' demand.

### **The layout of the thesis**

The thesis has: three pages in the introduction, Chapter 1: The overview: forty pages, Chapter 2: The object, content and research's method: ten pages, Chapter 3: The results and discussion: sixty-eight pages, Conclusion and suggestion. The thesis is also consist of number of tables, figures and ninety-nine references (thirty-nine Vietnamese references, sixty foreign references), appendix: eighteen pages.

## **CHAPTER 1: THE OVERVIEW**

### ***1.1. The genetical characteristics for production traits***

When researching characteristics about production function of feed chicken in special condition, it is the fact that researching the number

of characteristic heritabilities and the effect of environmental impact on those characteristics. Almost the characteristics about animals' production such as growth, reproduction, the speed of fearing are also the number of characteristics.

### ***1.2. The basic of poultry selection***

Creating is a primary solution in creating poultry lines, makes changes in heritability characteristics, the purpose of creating is to make follow generation that has production, higher quality than its parents. There are some creating methods:

Creating individual, creating follows family, family line, creating in family, creating individual that is combined to its family.

### ***1.3. The basic of the crossbreeding and the heterosis***

In the poultry hybrid, economic hybrid is the most popular method. The economic hybrid is a method that hybrids between two, three and four lines with the same chickens or the different ones to create commodity chickens, that are not used to be breed. Thus, we can use economic hybrid method to produce series of chickens and many quality products in a short time.

### ***1.4. The genetical characteristics for poultry production traits***

#### ***1.4.1. The growth***

In the biology part, growth is considered as a process to synthetic protein, so people often use the increase in weigh as a target to evaluate the growth process. To evaluate the characteristic about growth ability, people often use body weight targets, absolute growth speed, relative growth speed, fearing speed.

#### ***1.4.2. The poultry reproduction***

The ability of poultry reproduction is showed through the number characteristics such as age, egg production, reproduction ratio, embryo egg ratio and cosuming food per ten eggs.

#### ***1.4.3. The feed consumption ratio***

The consumption of food per a product unit is an important economic target in raising poultry. According to calculation, the cost for food often account 70-75 percent breed product price. So, the decrease in the cost of food is the top careness of geneticists. To reproduction chickens, the effect in using food is calculated as the consumption food per 10 eggs. To commercial chickens to take meat, the effect in using food is calculated as the consumption food per akg weigh.

### ***1.5. The situation of researching in the country and abroad***

In recent years, raising poultry has developed strongly and steadily. Having those achievements are due to many elements, the important element contributes decisively that is science and technology achievements about heritability, in which creating and hybrid are methods that are used broadly in Viet Nam and abroad.

#### ***The resources for creating poultry line***

In July, 2012, Thuy Phuong poultry research center imported high egg production chicken Tetra-SL of BÁBOLNA TETRA-SL Ltd Hungary consists of four unisexual lines: rooster A, hen B, rooster C, hen D. These were the chicken line that have high egg production chicken in present, grandparents chickens have egg production per a hen over seventy-two weeks reached 275-285 eggs, the egg weigh in 38 weeks old of the rooster line was 59.30g, hen line was 60.20g, egg production parental chickens per a hen over 72 weeks old was 300-305 eggs, the average of egg weigh was 60.50g, the ratio of yolk was 26-28 percent, the color of cover was dark brown.

HA1, HA2 chicken lines were researched and created from Egypt and Hyline chicken resources in 2006-2010 period. The two chicken lines at age of birth (5%): early from 132 to 134 days, the egg production over 38 weeks old: HA1 chickens were 87.25 eggs per a hen, HA2 chickens were 82.10 eggs, the egg production per a hen over 72 weeks old: HA1 chickens were 234.73 eggs, HA2 chickens were 229.48 eggs, consumed food per 10 eggs from 2.01 to 2.12kg. The egg quality was good, the ratio of yolk was 30.03-31.76%, the egg weigh at 38 weeks old from 47.43-49.30g.

## **CHAPTER 2: MATERIALS AND METHODS**

### **2.1. The material, place and time of researching**

#### ***2.1.1. The research's material***

GT1, GT2 lines were created from HA1 chicken resources with A rooster line, B hen line of high egg production Tetra-SL.

GT3, GT4 lines were created from HA2 chicken resources with C rooster line, D hen line of high egg production Tetra-SL.

#### ***2.1.2. The research's place and time***

- Carrying out at: Pho Yen raising chickens house –Thuy Phuong poultry research center

- The time research: From October 2012 to October 2016.

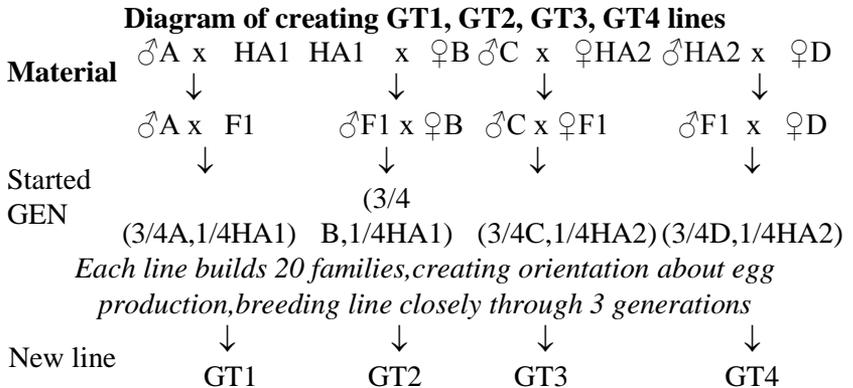
## 2.2. The researching content

1. Creating four grandparents chicken lines GT1, GT2, GT3 and GT4
2. Evaluating production targets of production hybrid parental chickens GT12, GT34 and commercial chickens GT1234.

## 2.3. The researching method

### 2.3.1. The research's method for the the first content

From the heritability materials of created chicken lines HA1, HA2 and domestic high egg production chicken lines Tetra-SL to create GT1, GT2, GT3 and GT4 follow the following diagram:



The main selection targets

The Appearance characteristics: GT1, GT2 were created by the brown feather and light brown feather. GT3, GT4 were created by the white feather.

- *The growth characteristic*

+ Body weigh at 9 weeks old: Creating stably ( $X_{TB} \pm 2\sigma$ ) to hens and  $X_{TB} \pm \sigma$  to roosters. The number of chickens and the ratio of reality creading are showed by the following table:

**Chicken scale and the ratio of selecting at 9 weeks old**

Line	Gen der	Explain	Started GEN	1 <sup>st</sup> GEN	2 <sup>nd</sup> GEN	3 <sup>rd</sup> GEN
GT1	Roo ster	Number (chicken)	194	387	438	534
		The ratio of selection (%)	49.48	15.50	16.67	14.98
	Hen	Number (chicken)	519	576	654	504
		The ratio of selection	85.16	81.60	81.19	82.94

		(%)				
GT2	Roo ster	Number (chicken)	194	375	469	758
		The ratio of selection (%)	51.55	16.00	17.06	10.55
	Hen	Number (chicken)	701	591	815	737
		The ratio of selection (%)	85.45	66.67	81.72	80.60
GT3	Roo ster	Number (chicken)	195	450	595	697
		The ratio of selection (%)	52.82	16.67	16.81	13.92
	Hen	Number (chicken)	596	609	635	687
		The ratio of selection (%)	85.07	80.13	83.31	85.44
GT4	Roo ster	Number (chicken)	217	328	400	942
		The ratio of selection (%)	52.53	18.29	21.25	19.96
	Hen	Number (chicken)	747	730	900	980
		The ratio of selection (%)	87.01	80.14	80.22	87.76

+ Body weigh at 19 weeks old: Creating stably, choose individual which has weigh around average value ( $\text{Mean} \pm 2\sigma$ ). The number of chickens and the ratio of creating are showed as the following table:

**Hen scale and the ratio of selecting at 19 weeks old**

Line	Explain	Started GEN	1 <sup>st</sup> GEN	2 <sup>nd</sup> GEN	3 <sup>rd</sup> GEN
GT1	Number of hen	425	452	511	403
	selection ratio (%)	91.92	71.46	70.84	75.93
GT2	Number of hen	577	379	640	574
	selection ratio (%)	70.66	84.51	72.66	73.23
GT3	Number of hen	487	469	508	568
	selection ratio (%)	81.26	70.79	80.31	71.83
GT4	Number of hen	629	564	694	830
	selection ratio (%)	64.11	56.45	71.72	52.29

- *Reproduction characteristic*: The egg production from 20 to 38 weeks old: Observing egg production of an individual from 20 to 38 weeks old. Orientation creating about egg production. The number of chicken and the ratio of creating are showed by the following table:

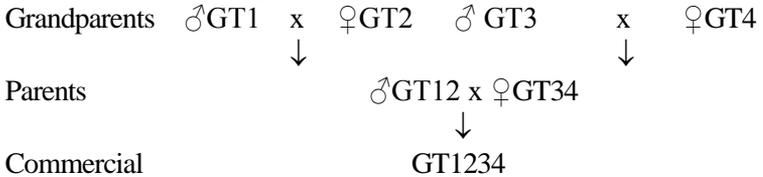
**Scale chicken and the ratio of selecting at 38 weeks old**

Line	Parameter	Started GEN	1 <sup>st</sup> GEN	2 <sup>nd</sup> GEN	3 <sup>rd</sup> GEN
GT1	Number of hens	383	300	320	300
	The selection ratio (%)	51.96	37.67	41.25	46.67
GT2	Number of hens	290	314	450	300
	The selection ratio (%)	56.21	43.31	34.89	46.00
GT3	Number of hens	388	300	400	400
	The selection ratio (%)	53.87	51.33	50.75	51.25
GT4	Number of hens	380	300	465	400
	The selection ratio (%)	50.00	50.67	47.74	50.00

Applying creating method in family, creating roosters, hens to collect hatching eggs to replace for the next generation

**2.3.2. The research method for the second content**

\*Diagram of hybriding parental and commercial chickens:



\*Experiment arrangement

Each plot arranges 90 roosters and 510 hens 1 day old that are cared, fed by the same regime to choose in reproduction and arranged follow the diagram 2.1, 2.2:

**Table 2.1: Arranging experiment to evaluate parental chickens production (GT12) and choose in reproduction**

Explain	GT1 line	GT2 line	GT12 parents
The reproduction stock	♂10+♀100	♂10+♀100	♂10+♀100
Replication (time)	3	3	3
Total of chicken	♂30+♀300	♂30+♀300	♂30+♀300

**Table 2.2: Arranging experiment to evaluate parental chickens production (GT34) and choose in reproduction**

Explain	GT1 line	GT2 line	GT12 parents
The reproduction stock	♂10+♀100	♂10+♀100	♂10+♀100
Replication (times)	3	3	3
Total of chicken	♂30+♀300	♂30+♀300	♂30+♀300

**Table 2.3: Arranging experiment to evaluate GT1234 commercial chickens**

Chicken	GT12	GT34	GT1234
Number of chicken 1 day old	450	450	450
Reproduction period			
The reproduction stock	100	100	100
Repeataation (time)	3	3	3
Total of chicken	300	300	300

Observation characteristics: the ratio of feed (%), body weight (g), egg production (egg), egg weight (g), egg quality, consume food over 10 eggs (kg), heterosis.

The regime careness, feed are applied by high egg chicken rasing procedure of Thuy Phuong poultry research center.

### 2.3.3. The statistical analysis methods

#### *Data collection*

The chicken breeds are individually numbered at 1 day old and after that follows the pedigree according to each generation. Follow the production to number laying hens and record in egg dotted. Finish 38 weeks, we create follow individual egg. Transplanting in families in individual house system. Each individual cell transplants one rooster and ten hens. Each generation transplants twenty families. Breeding eggs which are taken to replace for next generation and marked privately for each family, each hen, each line. Eggs are sorted in individual tray. Numbers are collected by scales and count.

#### *The statistical analysis method*

Comparing growth and reproduction traits, applying general linear model GLM on the software Minitab 16, used in statistical model:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + e_{ijk}$$

Where,  $Y_{ijk}$ : Phynotypic value of trait,  $\mu$ : average value of data form from analysis characteristic,  $\alpha_i$ : effect of  $\beta_j$  line:  $e_{ijk}$  random error.

Response selection (Re) is calculated by:  $Re = i\delta_p h^2$

$$\Delta G = \frac{R}{L} = \frac{i\delta_p h^2}{L}$$

Where, R is response to selection, i is selection intensity,  $\delta_p$  is phenotypic standard deviation,  $h^2$  is heritability coeffecient. L is generation time, is often used generation unit by generation/year.

#### *The heritability estimating method*

Analysis variance ingredient, united variance and heritability parameters of research characteristics that are estimated by maximum similarity method and REML, used statistical software VCE6 (2010).

The statistical analysis heritability model for 19 weeks old body weigh characteristic:

$$Y_{ijklm} = \mu + HYS_i + S_j + m_k + a_l + e_{ijklm}$$

Where:  $Y_{ijklm}$ : Phenotypic value of individual observation,  $\mu$ : average of population value,  $HYS_i$ : effect of chicken, year, season.  $S_j$ : effect of gender,  $m_k$ : effect of mother,  $a_l$ : effect of genetic additive and  $e_{ijklm}$ : random error.

The statistical analysis of heritability model for egg traits:

$$Y_{ijkl} = \mu + HYS_i + m_j + a_k + e_{ijkl}$$

Where:  $Y_{ijkl}$ : Phenotypic value of individual observation,  $\mu$ : average value of population,  $HYS_i$ : effect of chicken, year, season.  $S_j$ : effect of gender,  $m_k$ : effect of mother,  $a_l$ : effect of genetic additive and  $e_{ijkl}$ : random error.

Estimating chicken value by the BLUP.

- Coeffecience of heritability ( $h^2$ ) is caculated by:

$$h^2 = \delta_G^2 / \delta_P^2$$

Where,  $h^2$  is coeffecience of heritability,  $\delta_G^2$  is genetic variance and  $\delta_P^2$  is phenotypic variance.

### ***Evaluation method for selection response***

Evaluating lines both the phenotypic and the heritability, through statistical parameters about phenotypic value of production traits, genetic parameters: coeffecient of heritability, genetic correlation and genetic response.

## **CHAPTER 3: RESULT AND DISCUSSION**

### **3.1. The selecting four grandparental egg chicken lines GT1, GT2, GT3 và GT4 through four generations**

#### ***3.1.1. Appearance characteristic***

In the started gen, the feather color of GT1 chickens when they are 1 day old, is divided two main colors: brown and dark brown with the ratio 52.57 % and 47.43 %. In the 3<sup>rd</sup> gen, the numer of chicken with brown feather accounts for the ratio 78.45%, the numer of chickens with dark brown feather is 21.55%.

19 weeks old: 100% roosters have brown feather, GT1 hens: brown feather started gen accounts for 53.75%, 3<sup>rd</sup> generation: 88.66%, pale yellow with black spot in started generation: 46.25 %, 3<sup>rd</sup> gen: 11.34%.

Hence, through three generations with orientation of choosing brown feather color for GT1 chicken, GT2 chickens: When they are 1 day year started gen and the 1<sup>st</sup> gen, GT2 chickens have three feather colors: brown, black brown and white, white with black stripe. At 19 weeks old, GT2 started generation roosters with brown feather account for 79.43% and white with black spot color accounts for 20.57%, GT2 hens with brown feather accounts for 40.92%, pale yellow with black spot feather: 39.67% and white with black spot color 19.41%.

The 3<sup>rd</sup> generation has the ratio of light yellow with black spot feather color increases gradually and reaches 79.48%, and brown feather colors decreases 20.52%.

Thus, through three generations with orientation of choosing brown light yellow with black spot feather color for GT2 hens.

GT3, GT4 chickens: they have homogeneous white color, yellow feet. Hens at 19 weeks old have slim bodies, fast shapes, small heads, red warts. Roosters have bright red warts, their backs are covered by slick white feather.

### **3.1.2. *The surviving ratio***

The surviving rate of chicks in the period of 1-9 weeks old and backstroke period of 10-19 weeks old through GT1 generations reached over 96%. Comparing to the experiment result of Phung Duc Tien et al, (2010) HA1 and HA2 chicken at 1-9 weeks old period, the surviving rate reached sequencely 97.33-98.72% and 95.30-97.20%, 10-19 weeks old has the ratio of feed 96.12-97.95%, GT1 chickens have similar results.

The surviving ratio of GT2 chicks period is rather high, roosters and hens are over 96%. At broiler chicken, backstroke period (10-19 weeks old) roosters and hens are from 96.10 % to 97.00 %.

The surviving ratio of GT3 chickens through generations are high, chicks period are over 96%, GT4 chickens also have high surviving rate and stable through generations. It demonstrates that chickens are raised in good raising condition with careness process, veterinary hygiene, prevention disease which are suitable to high egg production chickens.

### **3.1.3. *The phenotypic values of body weight at 9 weeks old***

Because the need of choosing roosters is little, we only choose the ones which have feather colors, shapes, appearances suitable to creating purpose., combine to egg production of hens to choose. In detailed, GT1 roosters are from 14.98% to 16.67%, GT2 chickens are from 12.93% to 17.06%, GT3 chickens are from 13.92% to 16.81% and GT4 chickens are from 14.98% to 21.25%. The creating weight is about 950.97-970.44 g. To hens, the ratio of creating four hens lines through three creating generation is about 66.67-87.76%. The weight is created stably through three generations reach average from 759.08g to 765.05g. The result levelness of hens increases and shows at standard acceleration that decreases through generations.

**Table 3.4. The selecting result at 9 weeks old follow generation**

	<b>Gender</b>	<b>Target</b>	<b>Started GEN</b>	<b>1<sup>st</sup> GEN</b>	<b>2<sup>nd</sup> GEN</b>	<b>3<sup>rd</sup> GEN</b>
GT1	Rooster	Average weight (g)	997.47	982.04	977.36	980.98
		Standard deviation ( $\delta$ )(g)	87.65	74.60	73.72	73.99
	Hen	Average weight (g)	772.25	775.40	782.71	776.59
		Standard deviation ( $\delta$ )(g)	74.69	62.66	60.79	59.08
GT2	Rooster	Average weight (g)	985.03	950.96	977.37	975.15
		Standard deviation ( $\delta$ )(g)	95.26	72.19	73.64	73.44
	Hen	Average weight (g)	782.29	796.33	782.86	792.02
		Standard deviation ( $\delta$ )(g)	72.45	59.51	62.42	57.65
GT3	Rooster	Average weight (g)	970.30	966.53	970.87	969.17
		Standard deviation ( $\delta$ )(g)	87.74	72.93	75.81	83.95
	Hen	Average weight (g)	743.97	767.67	769.91	776.07
		Standard deviation ( $\delta$ )(g)	63.38	57.70	56.62	62.79
GT4	Rooster	Average weight (g)	964.95	956.40	961.83	961.45
		Standard deviation ( $\delta$ )(g)	94.14	71.03	76.41	81.19
	Hen	Average weight (g)	765.05	759.08	765.47	761.43
		Standard deviation ( $\delta$ )(g)	64.88	57.70	62.73	66.08

**3.1.4. The phenotypic values of body weight at 19 weeks old**

**Table 3.5. The selecting result of hens at 19 weeks old**

	<b>Target</b>	<b>Started GEN</b>	<b>1<sup>st</sup> GEN</b>	<b>2<sup>nd</sup> GEN</b>	<b>3<sup>rd</sup> GEN</b>
GT1	Average weight (g)	1441.91	1447.92	1448.06	1457.50

	Standard difference ( $\delta$ )(g)	118.04	99.53	112.34	86.95
GT2	Average weight (g)	1491.00	1482.48	1466.55	1484.27
	Standard difference ( $\delta$ )(g)	101.65	108.62	106.41	93.01
GT3	Average weight (g)	1449.89	1448.87	1448.95	1449.69
	Standard difference ( $\delta$ )(g)	107.93	95.12	92.97	87.18
GT4	Average weight (g)	1435.55	1438.10	1456.19	1439.18
	Standard difference ( $\delta$ )(g)	96.36	99.18	94.90	99.99

Through three creating generations, hens' body weight are from 143.55 to 1491.00g. The standard difference has decreased tendency. It is showed that 19 weeks old hens are rather equal when they lay eggs.

### **3.1.5. The consumption of feed at 1-19 weeks old period**

The feed consumption of four chickens lines through generations are similar. Chick period, GT1 roosters consume from 2308 to 2398g, hens consume from 2095 to 2194g. Similar to GT2 chickens, roosters are from 2312 to 2395g, hens are 2106 to 2204g, GT3 chickens : roosters are from 2305 to 2306, hens are from 2082 to 2112, GT4 chickens: roosters are from 2263 to 2351g, hens are from 2070 to 2151 gr.

Broiler chickens period (10-19 weeks old): The feed consumption of roosters in four chickens lines are from 5859 to 5933g, hens are from 5135 to 5232g. At 1-19 weeks old, roosters are from 8123 to 8158 gr, hens are from 7183 to 7311g.

### **3.1.6. Laying age, hen weight and egg weight**

At birth age 5% GT1 chickens are relatively stable and have decreased tendency through generations, oscillate in 135-138 days. The birth age is 30 % from 149-153 days,. The birth age is 50% from 164-167 days.

Hen weight when the ratio of laying 5% at started generation is higher 1508.00g than the first generation, the second generation, the third generation ( $P < 0.05$ ). The hens' body weight and egg weight increases gradually through laying periods. At 38 weeks old, GT1 hens' body weight, egg weight through generations are similar from 1851 to 1855.67g and 54.20-54.87g ( $P > 0.05$ )

GT2 chickens through generations have birth age 5% in about 134-139 days and decreased tendency through generations. At 38 weeks old GT2 hens' weight are 1859.67-1866.67g, egg weights are 54.25-54.85g. Hens' weight and egg weight through GT2 chicken generations are similar ( $P > 0.05$ ).

GT3 chickens at birth age 5% through generations are stable, in about 135-137 days. At 38 weeks old, GT3 hens' weight are 1843.30-1851.33g, egg weight are 54.08-54.50g.

GT4 chickens, hens weight at laying period are 1444.00-1456.00 and stable between generations. Especially, coefficient variation (CV) is small from 7.25 to 8.20%, that shows chickens at laying period have high equal 1834.67-1842.67g, egg weight 54.06-54.94g.

**3.1.7. The phenotypic values of egg production at 38 weeks old**

The four creating chicken lines are choosed toward to advanced egg production. With the ratio of creating through three generations from 37.67-51.96%, this is a rather strict creating ratio. The result is a difference standard which has decreased tendency through creating generations from 14.97 eggs to 18.71 eggs.

**Table 3.8: The egg production 38 weeks old**

	Target	Started GEN	1 <sup>st</sup> GEN	2 <sup>nd</sup> GEN	3 <sup>rd</sup> GEN
GT1	Egg production (egg)	82.08	92.86	93.56	94.21
	Difference standard ( $\delta$ ) (g)	16.06	15.39	14.97	16.48
	Creating intensity (i)	0.78	0.97	0.93	9.81
	Re for egg production (egg)		4.05	3.47	1.87
GT2	Egg production (egg)	81.56	86.80	89.91	92.72
	Difference standard ( $\delta$ ) (g)	18.71	19.62	16.01	16.28
	Creating intensity (i)	0.73	0.90	1.08	0.88
	Re for egg production (egg)		4.06	3.46	2.88
GT3	Egg production (egg)	88.32	91.28	91.77	92.79
	Difference standard ( $\delta$ ) (g)	18.09	16.65	15.47	16.74
	Creating intensity (i)	0.75	0.78	0.83	0.74
	Re for egg production (egg)		4.00	3.74	3.34
GT4	Egg production (egg)	84.60	90.60	90.62	91.72
	Difference standard ( $\delta$ ) (g)	17.03	15.95	15.76	15.80
	Creating intensity (i)	0.79	0.83	0.87	0.83
	Re for egg production (egg)		3.69	2.73	2.37

The difference standard decreases gradually through generation, synonyms to heritability variance and has decreased trend, heritability coefficient also has decreased trend through creating generations and shows to effective creating. The analysis result shows that effective

creating through generations has decreased trend through creating generations.

Through three creating generations, GT1 egg production increased 12.13 eggs and were similar to 4.04 eggs over one generation. Similarly, GT2 chickens increased average 3.72 eggs over one generation, GT3 chickens increased 1.49 eggs over one generation and GT4 chickens increased 2.37 eggs over one generation.

**3.1.8. Component variances and heritability coefficient of selection characteristics**

When creating characteristics, characteristic is interested in creating, the gene frequency of that characteristic will have gradual increased trend through each generation. However, changing heritability variance ingredient is a change of environmental variance ingredient and makes a change in heritability coefficient at very little level and almost trivial. This is shows that the stabledment of heritability coefficients increase and the standard error of heritability coefficient fall down about 0.01-0.04.

**Table 3.9: Component variances, heritability of egg production**

	<b>Parameter</b>	<b>GEN 1</b>	<b>GEN 2</b>	<b>GEN 3</b>
GT1	Heritability variance ( $\sigma^2_G$ )	95.27	77.29	39.77
	Environmental variance ( $\sigma^2_E$ )	206.81	187.30	221.92
	Hen's variance ( $\sigma^2_M$ )	44.57	39.29	17.27
	$h^2 \pm SE$	0.27±0.02	0.25±0.01	0.14±0.04
GT2	Heritability variance ( $\sigma^2_G$ )	104.79	89.33	82.74
	Environmental variance ( $\sigma^2_E$ )	326.27	297.70	309.30
	Hen's variance ( $\sigma^2_M$ )	14.08	43.39	15.93
	$h^2 \pm SE$	0.23±0.08	0.20±0.03	0.20±0.03
GT3	Heritability variance ( $\sigma^2_G$ )	147.69	116.81	96.70
	Environmental variance ( $\sigma^2_E$ )	322.96	246.44	241.92
	Hen's variance ( $\sigma^2_M$ )	0.00	39.05	15.14
	$h^2 \pm SE$	0.31±0.02	0.29±0.01	0.27±0.05
GT4	Heritability variance ( $\sigma^2_G$ )	102.67	69.51	57.05
	Environmental variance ( $\sigma^2_E$ )	249.80	239.15	247.38
	Hen's variance ( $\sigma^2_M$ )	2.15	33.50	0.35
	$h^2 \pm SE$	0.28±0.02	0.20±0.03	0.18±0.02

The heritability coefficient of each characteristic belongs to heritability element, invironment and calculating method. When the heritability coefficient of a characteristic is at high level, the correlation between

phenotypic and genotype of individuals will be high, the creating bases on phenotypic value of that individual will bring efficient. In contrast, the heritability coefficient of low characteristic shows that the genotype affect of low individual is affected by high environment. In that condition, needing combine itself production with relative production and its' chick to improve creating efficient.

Hence, the heritability nature of egg production characteristic 20-38 weeks old of four chicken lines GT1, GT2, GT3 and GT4 has clear and stable trend through three creating generations from the first generation to the third generation. It is shows that the creating method is suitable and the selection efficient collected relatively good result.

**Table 3.10: Phenotypic and heritability correlation between 19 weeks old body weight and 38 weeks old egg production of four chicken lines**

Chicken line	Parameter	1 <sup>st</sup> generation	2 <sup>nd</sup> generation	3 <sup>rd</sup> generation
GT1	Heritability correlation coefficient ( $r_G \pm SE$ )	-0.56 $\pm$ 0.03	-0.61 $\pm$ 0.04	-0.86 $\pm$ 0.13
	Phenotypic correlation coefficient ( $r_P$ )	-0.67	-0.50	-0.46
GT2	Heritability correlation coefficient ( $r_G \pm SE$ )	-0.46 $\pm$ 0.21	-0.45 $\pm$ 0.11	-0.40 $\pm$ 0.07
	Phenotypic correlation coefficient ( $r_P$ )	-0.49	-0.33	-0.39
GT3	Heritability correlation coefficient ( $r_G \pm SE$ )	-0.19 $\pm$ 0.05	-0.09 $\pm$ 0.04	-0.34 $\pm$ 0.04
	Phenotypic correlation coefficient ( $r_P$ )	-0.31	-0.37	-0.53
GT4	Heritability correlation coefficient ( $r_G \pm SE$ )	-0.46 $\pm$ 0.05	-0.43 $\pm$ 0.05	-0.45 $\pm$ 0.05
	Phenotypic correlation coefficient ( $r_P$ )	-0.51	-0.52	-0.39

The research result at table 3.10 shows heritability correlation coefficient between 19 weeks old body weight and chromosome 20-38 weeks old of four chickens lines through generations are tight, except for GT3 chicken and negative values, shows that they have contradictory genes relationship.

The confirmation of heritability correlation between 19 weeks old body weight and chromosome 20-38 weeks old is a science base for breeders in breeding purpose, who can decrease the number of characteristic used in creating to improve exact level of creating characteristic in breed creating.

Phenotypic correlation coefficient between 19 weeks old body weight and chromosome 20-38 weeks old of four chicken lines through generations bring negative value and are tight similarly to heritability correlation coefficient.

The confirmation of heritability correlations and phenotypic between interested characteristics in creating purpose is necessary to decrease the number of creating characteristic to upgrade the exact of creating, and save the cost of observation, record and collection individual data, serve breed mission.

### ***3.1.9. Genetic trend and progress of selecting traits***

The research on GT1 chicken line showed that estimated breed value of egg production characteristic through each generation from -1.25 eggs at started generation to 2.81 eggs at the third generation, heritability trend also increased. So, the heritability essence of characteristic were higher and more convergent. The egg production had heritability progress (same rooster hen), was 1.282 eggs over one generation. The regression confirmation coefficient of this characteristic was rather high  $R^2=0.94$  to egg production characteristic ( $P<0.01$ ).

At GT2 chicken line, the estimated breed value and heritability trend of egg production characteristic had increased trend through each generation. However, the total change of elements affected to egg production characteristic which was brought to research, compared to the total of change and affected to egg production characteristic, reached low average (43%) led to change fluctuation index between unsimilar generations.

At GT3 chicken line, the estimated breed value of egg production characteristic increased through each generation from -0.7 eggs at started generation to 2.66 eggs at the third generation, heritability trend also increased through each generation. The egg production with heritability progress was 1.03 eggs over one generation. The regression confirmation coefficient of this characteristic was rather high with  $R^2=0.87$  to egg production characteristic ( $P<0.001$ ).

GT4 chicken line, the average of breed value from -0.18 eggs at the started generation to 2.48 eggs at the third generation. The general regression coefficient for both roosters and hens reached highly 96%.

It is showed that the linear regression was suitable to the data used in research. The heritability progress of the characteristic was improved clearly and showed through the positive regression coefficient. The chromosome had heritability progress (the same rooster hen) and reached 0.87 eggs per a generation.

### ***3.1.10. The laying ratio and egg production of the four chicken lines***

GT1 chickens, the ratio of laying was low at the first weeks, after that it increased gradually and reached to the top from 28 to 31 weeks old, was 83.94, 89.57, 90.71 and 90.72%. At 68 weeks old, the average ratio of laying through generations was 67.32, 69.65, 71.70 and 72.23%. So through creating generations, the ratio of laying at 68 weeks old of GT1 the third generation increased higher than the started generation 4.9. The chromosome per a hen over 68 weeks old increased gradually from the started generation to the third generation and reached 246.54 eggs, compared to the started generation to the third generation, the chromosome increased 17.54 eggs, similar to 7.60%.

GT2 chicken line had low laying ratio at the first week, after that it increased gradually and reached to the high top from 86.01, 84.67, 87.24 and 88.98%. At 68 weeks old, the average ratio of laying through generations was 67.94, 69.01, 71.57 and 81.81%. So, the average laying ratio increased through generations. Comparing to the started generation, the average laying ratio increased 3.87% in third generation. The egg production per a hen over 68 weeks old reached 233.05 eggs at the started generation, 236.72 eggs at the first generation, 245.47 eggs at the second generation, 246.90 eggs at the third generation.

The laying ratio of GT3 chicken increased from the 24<sup>th</sup> week, the laying ratio was high and prolonged through out the next time. At the 38<sup>th</sup> week the average laying ratio increased through generations reached 68.96, 69.57, 70.57 and 70.01%. The chromosome per a hen over 68 weeks old, GT3 chickens reached 236.17 eggs at the started generation, 240.06 eggs at the first generation, 242.99 eggs at the third generation.

GT4 chickens increased quickly from the 24<sup>th</sup> week and maintained the high laying ratio at the next weeks. At the 68<sup>th</sup> week the average ratio of laying through generations was 67.59, 69.65, 70.42 and 70.32%. So,

through three creating generations, the laying ratio of GT4 chicken increased 2.37%. The egg production per a hen over 68 weeks old of GT4 chicken reached 231.84 eggs at the started generation, 238.89 eggs at the first generation, 241.54 eggs at the second generation and 242.06 eggs at the third generation.

### ***3.1.11. The feed consumption over 10 eggs***

The feed consumption over 10 eggs through GT1 chicken generation was 1.74-1.91kg, GT2 chicken was 1.75-1.89kg, GT3 chicken was 1.76-1.86kg, GT4 chicken was 1.79-1.89kg. The results showed that the feed consumption over 10 eggs had decreased trend through generations. It means that feed using effecient or economy effecient inceased.

Comparing to the started generation, the first and the second generations, the feed consumption at the third generation was lower. This one was completely suitable to rules as the egg production was high, the feed consumption was low.

### ***3.1.12. The hatched ratio of four chicken lines***

Through generations, the follow of hatching eggs from 38 weeks to 40 weeks showed that: GT1 chickens had the embryo ratio reached average 96.21-96.69%, the hatched ratio over hatching eggs 78.84-80.12%, the hatched ratio over embryo eggs 82.86-84.34%. Similarity to GT2 chickens were 95.01-97.29%, 80.01-81.36% and 84.45-85.14%. GT3 chickens reached 96.05-96.93%, 79.14-81.45%, 83.00-84.81%. GT4 chickens were 95.53-98.02%, 80.38-82.66, 84.47-85.74%.

## ***3.2. The evaluation of egg production of parental and commercial chickens***

### ***3.2.1. The egg production of parenal chicken of GT12 and GT34***

#### ***3.2.1.1. The surviving ratio and feed consumption***

The ratio of rasing GT1, GT2, GT12 and GT3, GT4, GT34 chickens at 1-9 weeks old period reached highly over 96%, broiler chickens period, backstroke period had the ratio of rasing 95.71-97.14%.

The quantity of feed consumption for total 1-19 weeks old period compared to GT1 and GT2 chickens: GT12 chickens had lower feed consumption level at this period from 63.14 to 71.12g and to roosters and hens were similar.

The quantity of feed consumption 1-19 weeks old period GT3, GT4 and GT34 chickens were 8222.34, 8162.42 and 8112.37g with roosters and 7232.68, 7210.28 and 7121.14 with hens.

### 3.2.1.2. *The body weight*

The body weight of roosters GT12 at 9 weeks old were lower than GT1, GT2 chickens ( $P<0.05$ ), at 19 weeks old GT2 chickens reached highest 1976.67g, the next ones were GT12 chickens 1954.67g, the lowest ones were GT1 1944.14g ( $P<0.05$ ). CV was low (6.26-8.33%).

At 9 weeks old, the body weight of hens GT1, GT2 and GT12 were different, the highest ones were GT1 chickens 761.17g, the next ones were GT2 749.33g, the lowest ones were GT12 741.67g ( $P<0.05$ ), chickens had equal high.

The weight of GT3, GT4 and GT34 roosters at 9 weeks old were sequence 968.33g, 970.33g and 949.33g, the variation coefficient was low from 5.87% to 7.50%, at 19 weeks old were 1918.00g, 1912.33g and 1936.33g, the variation coefficient was from 7.92% to 8.0%.

The weight of hens at 9 weeks old were from 7.46.67g to 755.17g, at 19 weeks old were from 1439.00g to 1448.33g ( $P>0.05$ ).

### 3.2.1.3. *The laying age, hens 'weight and eggs 'weight*

The birth age 5% of research chickens from 132 days to 137 days were similar to HA1 (131-135 days old) in the research of Phung Duc Tien et al.(2010), the laying ratio reached 50% on 157-162 days.

At 38 weeks old, the weight of GT3 and GT4 (1839.21g, 1844.89g) were similar to GT34 chickens 1833.11g ( $P>0.05$ ). The egg weight of GT3, GT4 chickens were lower than GT34 chickens ( $P<0.05$ ) with heterosis, comparing to the average of parental egg weight was 4.28%.

### 3.2.1.4. *The laying ratio*

The chickens laid eggs at the high top at 29-32 weeks old. Averagely, the laying ratio from 20 to 68 weeks old GT1 chickens were 70.12 %, GT2 chickens were 69.84%, GT12 chickens were 77.79%

The heterosis of the laying ratio of GT12 chickens compared to the average of parental chickens were 11.16%. The heterosis of laying ratio of GT34 chickens compared to the average of parental chickens were 8.77%.

### 3.2.1.5. *The egg production and feed consumption over 10 eggs*

GT12 chickens, the egg production was 263.24 eggs per a hen, comparing to the average of GT1 and GT2 with  $P<0.05$ . The heterosis of egg production of GT12 chickens compared to their parents 11.13%. The feed consumption level over 10 eggs of GT12 chickens was lower than

GT1 and GT2 chickens from 0.11kg to 0.13kg with the heterosis of the feed consumption -6.59% ( $P<0.05$ ).

The egg production per a hen over 68 weeks old of GT3, GT4 and GT34 were 240.63 eggs, 238.49 eggs, 260.32 eggs. The research result showed that the difference about egg production had difference ( $P<0.05$ ).

The feed consumption over 10 eggs of GT34 was lower than that of their parents. GT34 chickens were 1.72 kg, lower than the feed consumption of GT3 and GT4 chickens from 0.8kg to 0.9kg with the heterosis was -4.70% ( $P<0.05$ ).

**Table 3.12. The egg production and feed consumption over 10 eggs of four grandparents chickens GT1, GT2, GT3, GT4 and parental chickens GT12, GT34**

Period	GT1	GT2	GT12	GT3	GT4	GT34
20-24	9.56	9.19	12.48	12.29	11.88	13.44
25-28	20.43	19.24	22.44	20.69	19.88	22.22
29-32	24.2	24	25.68	25.1	24.53	25.37
33-36	22.86	23.2	24.79	23.86	23.45	24.82
37-40	21.9	22.99	23.62	22.9	22.55	23.35
41-44	22.2	22.21	22.92	22.12	22.11	22.81
45-48	21.92	21.61	22.71	21.53	21.46	22.65
49-52	21.12	20.9	22.8	20.91	20.52	22.48
53-56	19.81	20.15	22.51	19.65	19.58	22.04
57-60	18.88	19.13	21.92	18.24	18.82	20.88
61-64	17.96	17.1	21.78	17.01	17.39	20.42
65-68	16.65	16.53	19.62	16.32	16.33	19.84
Total (20-68)	237.50 <sup>b</sup>	236.24 <sup>c</sup>	263.24 <sup>a</sup>	240.63 <sup>B</sup>	238.49 <sup>C</sup>	260.32 <sup>A</sup>
Heterosis (%)			11.13			8.67
FCR/10 eggs	1.81 <sup>b</sup>	1.83 <sup>b</sup>	1.70 <sup>a</sup>	1.80 <sup>B</sup>	1.81 <sup>B</sup>	1.72 <sup>A</sup>
Heterosis (%)			-6.59			-4.7

*Note: Follow the row, the average values bring different alphabets, the difference is statistical significantly ( $P<0.05$ ).*

Therefore, the heterosis of egg production between GT34 chickens and their parents was high (8.67%). The heterosis of feed consumption over 10 eggs was -4.7%, comparing to their parents, brought high effective economy for breeders.

### 3.2.1.6. Egg quality of GT1, GT2, GT12 and GT3, GT4, GT34

GT1, GT2 and GT12 chickens had high yolk ratio from 30.06% to 30.61%, the yolk index was 0.43-0.45. Eggs had thick cover from 0.33mm to 0.35mm. Haugh unit was relatively high, reached from 86.76 to 87.95.

GT3, GT4 and GT34 chickens had high yolk ratio from 30.04% to 30.39%, the white index was 0.08-0.09, the yolk index was 0.43-0.45, eggs had Haugh from 86.76 to 87.66. Eggs' covers were thick from 0.34mm to 0.35mm.

#### *3.2.1.7. The hatched ratio of GT1, GT2, GT12 and GT3, GT4, GT34 chickens*

The hatching ratio of GT1, GT2 and GT12 chickens was high 96.41, 95.51 and 97.31%. The hatching ratio over hatching eggs was 79.67, 80.41 and 81.05%. The hatching ratio of GT3, GT4 and GT34 chickens showed that the embryo ratio was from 95.42% to 96.12%, the hatched ratio over hatching eggs was 79.60-80.54.

### **3.2.2. Evaluation the production of commercial chickens GT1234**

#### *3.2.2.1. The surviving ratio*

1-9 week old period, the raising ratio of T1234 chickens reached highly from 96.00% to 96.22%. 10-19 weeks old period the raising ratio was from 96.24-96.82%.

#### *3.2.2.2. The body weight*

At 19 weeks old hens were 1446.33-1459.46g. Chickens had low variation coefficient, that showed chickens had high similarity.

#### *3.2.2.3. The laying age, hens' weight and eggs' weight*

The laying age 5% of GT1234 chickens was 131 days and earlier than parental chickens 3-4 days, the high top birth age was 192 days, earlier than parental chickens 3-6 days. The body weight of GT12, GT34, GT1234 chickens increased through laying periods, at 38 weeks old hens' weight reached highest 1862.77g, the next ones were GT34 1842.66g, GT1234 chickens were 1838.33g ( $P<0.05$ ). The eggs' weight at 38 weeks old was lowest at GT12 chickens (54.21g) and highest at GT1234 chickens (57.60g) ( $P<0.05$ )

#### *3.2.2.4. The laying ratio, egg production and feed consumption over 10 eggs*

The high laying ratio of GT1234 chickens at 27-30 week was earlier than parental chickens, reached 92.65% and higher than parental chickens GT12, GT34 from 2.45% to 5.29%. The average of laying at 80 weeks old was 72.70%, heterosis of laying ratio was 2.09%.

The egg production per a hen over 80 weeks old of GT1234 chickens was 316.96 eggs per a hen and higher than parental chickens GT12, GT34 ( $P < 0.05$ ). The hybrid dominance about egg production compared to the average of parents was 2.00%.

The feed consumption of GT1234 chickens over 10 eggs averagely at 80 weeks was 1.54 kg, the heterosis of FCR was -4.35%.

**Table 3.70. The laying ratio, egg production and feed consumption over 10 eggs of parental chickens GT12, GT34 and commercial chickens GT1234 with their heterosis**

Period (week old)	GT12		GT34		GT1234	
	Laying ratio	Egg production	Laying ratio	Egg production	Laying ratio	Egg production
19-22	20.67	5.79	20.86	5.84	24.13	6.76
23-26	66.65	18.66	65.39	18.31	70.72	19.80
31-34	90.20	25.26	87.36	24.46	89.21	24.98
35-38	84.91	23.78	84.05	23.53	85.37	23.9
39-42	82.96	23.23	82.68	23.15	83.19	23.29
47-50	81.49	22.82	80.27	22.48	80.19	22.45
51-54	81.16	22.54	79.38	22.23	78.28	21.92
55-58	79.44	22.24	76.48	21.42	77.18	21.61
59-62	78.24	21.91	74.05	20.73	75.96	21.27
67-70	64.97	18.19	67.1	18.79	68.27	19.12
71-74	60.03	16.46	63.57	17.52	65.03	17.91
75-78	56.04	15.42	58.82	16.11	61.66	17.01
79-80	52.96	7.37	54.37	7.53	57.5	7.93
Average(%)	71.57		70.85		72.7	
Egg yield (egg)		312.39 <sup>b</sup>		309.07 <sup>c</sup>		316.96 <sup>a</sup>
Heterosis of laying ratio (%)			8.77			2.00
FCR/10 eggs (kg)	1.59 <sup>b</sup> ± 0.003		1.63 <sup>b</sup> ± 0.011		1.54 <sup>a</sup> ± 0.007	
Heterosis of FCR(%)					-4.35	

3.2.2.5. *The egg quality of parental chickens GT12, GT34 and commercial chickens GT1234*

The eggs' weight at the survey time GT12, GT34, GT1234 chickens were 55.08, 56.53, 57.66g. The color of eggs' cover was light pink and yolk ratio was from 30.00-30.12, were accepted by consumers.

The survey result showed that GT chickens have the thickness of cover 0.34-0.36mm, Haugh unit is 86.41-87.04.

## CONCLUSION AND SUGGESTION

### 1. Conclusion

#### 1.1. *Creating four grandparental egg production chicken lines through four generations*

Creating successful four grandparental egg production chicken lines GT1, GT2, GT3, GT4 through four generations that had following genetical characteristics and egg production:

\* *GT1 grandfather chicken line*: the mature rooster has homogeneous brown feather color, hen has light brown 88.66% and light yellow with black spot 11.34%. The heritability coefficient about egg production at 20-38 weeks old is 0.14. The phenotypic and heritability correlation between two characteristics with body weight at 19 weeks old and egg production at 20-38 weeks old have negative and high correlation (-0.86 and -0.46). The heritability progress reached, egg production was 1.28 eggs per a generation. The egg production per a hen over 38 weeks old was 94.21 eggs at the third generation. The average egg production per a hen over 68 weeks old was 248.33 eggs. The egg at 38 weeks old had medium weight 54.52 grams, the yolk ratio was high 30.61%. The hatched per hatching egg was 80.12% and egg covers were light brown color.

\* *GT2 grandmother chicken line*: the mature rooster has homogeneous brown feather color, hen has light yellow color 79.48% and brown color 20.52%. The heritability coefficient about egg production at 20-38 weeks old is 0.20. The phenotypic and heritability correlation between two characteristics with body weight at 19 weeks old and egg production at 20-38 weeks old have negative and intermediat correlation (-0.40 and -0.39). The heritability progress reached, egg production was 0.64 eggs per a generation. The egg production per a hen over 38 weeks old was 92.72 eggs at the third generation. The average egg production per a hen over 68 weeks old was 246.90 eggs. The egg at 38 weeks old had medium weight 54.44

grams, the yolk ratio was high 30.11%. The hatched per hatching egg was 81.36% and egg covers were light brown color.

\* *GT3 grandfather chicken line*: The feather is homogeneous white. The heritability coefficient about egg production at 20-38 weeks old is 0.27%. The phenotypic and heritability correlation between two characteristics with body weight at 19 weeks old and egg production at 20-38 weeks old have the negative and intermediat correlation (-0.34 and -0.53). The heritability progress reached, egg production was 1.03 eggs per a generation. The egg production per a hen over 38 weeks old was 92.79 eggs at the third generation. The average egg production per a hen over 68 weeks old was 244.92 eggs. The egg at 38 weeks old had medium weight 54.46 grams, the yolk ratio was high 30.09%. The hatched per hatching egg was 81.45% and egg covers were light pink color.

\* *GT4 grandmother chicken line*: The feather is homogeneous white. The heritability coefficient about egg production at 20-38 weeks old is 0.18%. The phenotypic and heritability correlation between two characteristics with body weight at 19 weeks old and egg production at 20-38 weeks old have the negative and intermediat correlation (-0.45 and -0.39). The heritability progress reached, egg production was 0.87 eggs per a generation. The average egg production per a hen over 38 weeks old was 91.72 eggs at the third generation. The average egg production per a hen over 68 weeks old was 242.06 eggs. The egg at 38 weeks old had medium weight 54.31 grams, the yolk ratio was high 30.10%. The hatched per hatching egg was 82.66% and egg covers were light pink color.

### ***1.2. Creating egg production parental chickens GT12, GT34 and commercial chicken GT1234 with high production***

Creating egg production parental hybrid chickens GT12, GT34 and commercial chicken GT1234 with high egg production.

\* *GT12 and GT34 parental chickens*: The rasing ratio at backstroke reached over 96%. The average egg production at 68 weeks old of GT12 and GT34 was sequency 263.24 eggs per a hen and 260.32 eggs per a hen with heritability for egg production 11.13% and 8.67%. The average feed consumption per 10 eggs was 1.59 kilograms and 1.63 kilograms with the negative heterossis (-4.70% and -6.59%). The average egg weight was 54.2 grams and 56.6 grams; the average hatching egg was 79.60% and 81.05%.

\* *GT1234 hybrid commercial chicken*: The raising ratio at backstroke reached over 96%. The laying ratio at 80 weeks old was averagely 72.70%, the average egg production per a hen over 80 weeks old was 316.96% with the heterossis of 2.00%. The feed consumption per 10 eggs was 1.54 kilograms with the negative heterossis of -4.35%. The average egg weight was 57.6 grams, the yolk ratio was 30.19% and the egg covers were light pink color which were suitable to consumers.

## **2. Suggestion**

Continuing selecting for appearance characteristics of GT1 and GT2 chickens, selectting for egg production for GT1, GT2 chickens and imrove egg weight of GT3, GT4 chicken lines.

### **THE CATEGORY OF SCIENTIFIC WORKS WERE ANNOUNCED THAT RELATED TO THE THESIS**

Tran Ngọc Tien, Nguyen Huy Dat, Nguyen Quy Khiem, Pham Thuy Linh, Pham Thi Hue and Nguyen Thi Hong Tham, 2017. The heritabilities and correlations between the body weight and egg productivity of four egg chicken lines GT1, GT2, GT3 and GT4 through three generations. *Journal of Animal Husbandry Sciences and Technics*, 227(12.17): 8-13.

Tran Ngoc Tien, Nguyen Quy Khiem and Pham Thuy Linh, 2018. The production ability of GT12, GT34 parental chickens and GT1234 hybrid commercial chicken. *Journal of Animal Husbandry Sciences and Technics*, 231(4.18): 7-13.