

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

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**CONFORMATION, PRODUCTION ABILITY OF  
CROSSBREEDING AMONG 15 – DAI XUYEN SEA DUCK,  
MALLAR AND STAR 53**

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## **PUBLISHED PAPERS RELATED TO THE THESIS**

- 1. Le Thi Mai Hoa, Hoang Van Tieu, Nguyen Van Duy, Vuong Thi Lan Anh, Dang Vu Hoa, Van Thi Chieu, Do Thi Lien and Dao Anh Tien. 2021. Conformation and production ability of two-breed BT and TB crossbred ducks. Journal of Livestock Science and Technology No. 128, October 2021. Pages 34 - 46.**
- 2. Le Thi Mai Hoa, Hoang Van Tieu, Nguyen Van Duy, Dang Vu Hoa, Vuong Thi Lan Anh, Hoang Bich Ngoc, Nguyen Ngoc Giap, Nguyen Thi Hong and Nguyen Thi Thu Phuong. 2021. Growth and meat yield of commercial crossbred ducks of three breed SBT and STB crossbred ducks. Journal of Livestock Science and Technology No. 128 October 2021. Pages 47 - 59.**
- 3. Le Thi Mai Hoa, Hoang Van Tieu, Nguyen Van Duy, Dang Vu Hoa, Vuong Thi Lan Anh, Hoang Bich Ngoc, Nguyen Ngoc Giap, Dao Anh Tien and Nguyen Thi Thu Phuong. 2022. Meat quality of commercial crossbred ducks of three breed STB and SBT ducks. Journal of Livestock Science and Technology No. 276 April 2022. Pages 7-13.**

## INTRODUCTION

### 1. Rationable

Due to climate change in recent years, which has led to the fact that some areas suffer from drought and saltwater intrusion, it is difficult for people to develop their economy in today's society. However, there are very few livestock breeds that can adapt to climate change in our country. In the requirement of selection and breeding for waterfowl breeds need with many new high yield and quality lines and breeds, taking advantage of heterosis to bring high economic efficiency in production and adaptability, it is essential climate change adaptation.

15 - Dai Xuyen Sea Duck is a breed of duck that can be raised in freshwater, brackish and saltwater conditions, with great potential to open up many future research directions on salt tolerance and salt elimination mechanism in the body. The egg yield of 15 - Dai Xuyen Sea Duck was high with 247.56 - 248.25 eggs/hen/52 weeks of laying, body weight of commercial ducks at the end of 8 weeks of age was 2199 - 2296 g/hen, carcass rate was over 69%, the meat quality was delicious, but duck breast meat rate was only 16 - 17% (Nguyen Van Duy et al., 2016).

In recent years, mallard has been interested and popular, with advantage of delicious meat quality, easy adaptability, good bait, etc. The meat of mullard becomes a specialty for high income people. However, the mallard laied few eggs, the body weight was small with 1055.83-1196.63 g/duck, so it is difficult to grow this duck breed (Nguyen Dang Cuong, 2018).

Star 53 duck breed was imported and kept at Dai Xuyen Duck Research Center from Grimaud Group - France in 2016 with high yield and quality. Star 53 Duck has white feathers that are very suitable for the tastes of Vietnamese consumers today; commercial ducks up to 7 weeks age was 3685.57 g/duck, feed consumption/kg body weight gain was 2.28 kg; breast meat rate was 22.88%; Laying age of parent was at 25 weeks age, the weight at laying was

3240.43 g/hen and 4159.05 g/drum, egg yield was 220.08 eggs/hen/42 weeks laying (Nguyen Van Duy et al. ., 2020) but Star 53 ducks have poor foraging ability and are inclined towards industrial farming.

From the gene resources of three 15 - Dai Xuyen sea, Mullar and Star 53 ducks, create a two-breed crossbred conbiantions with high egg production ability, good egg quality and a three- crossbred conbiantions with high yield and quality were created. Meanwhile, high meat quality, and well adapted to brackish and saltwater conditions, the topic "conformation, production ability of crossbreeding among 15 - Dai Xuyen Sea Duck, mallard and Star 53" was conducted

## **2. OBJECTIVE OF STUDY**

### **2.1. Overall objective**

Identify proper crossing for duck production to adapt to climate change.

### **2.2. Specific objective**

- Determined conformation, production ability of a two-breed crossbred (15 - Dai Xuyen sea duck, mallard) and a three-breed crossbred (15 - Dai Xuyen sea duck, mallard, Star 53 duck).

- Determined the most suitable crossbred of two and three breeds for the development of waterfowl breeding.

## **3. NEW CONTRIBUTORS OF THESIS**

This is a systematic and creative scientific research work with high practical value. For the first time from the genetic resources of 15 - Dai Xuyen sea duck, mallard and Star 53 duck, by common crossings, two BT crossbred ducks were created for breeding and three SBT crossbred ducks were raised for meat and adapted to saline intrusion area.

## **4. SCIENTIFIC AND PRACTICAL VALUE OF THESIS**

### **4.1. Scientific value**

- On the basis of science for heterosis and effective exploitation of 15 - Dai Xuyen duck mallard, Star 53 duck gene resources was created by two

breeds (BT) for breeding (breeding and taking eggs) and three-breed crossbred (SBT) raising for meat with high yield and quality transferred for production suitable to saltwater, brackish and freshwater condition. Contributed to protecting biodiversity as well as developing a sustainable ecological agriculture, bringing economic efficiency to farmers.

- The results of the thesis are valuable references in the research, training and development of waterfowl raising

#### **4.2. Practical value**

- Created two-breed crossbred ducks (BT) with small body weight, high egg yield, low feed consumption, usable in two directions of breeding and egg raising, both gave high breeding efficiency.

- Created high-yield, high-quality meat-raising crossbred ducks that can adapt to freshwater, brackish and saltwater conditions

## **Chapter 1. LITERATURE REVIEW**

### **1.1. SCIENTIFIC BASIS OF THESIS**

The research problem of the thesis is based on the science of conformation, heterosis, vitality and disease resistance, fertility, growth and meat production of waterfowl.

### **1.2. RESEARCH SITUATION IN VIETNAM AND INTERNATIONAL**

The thesis has evaluated the situation of international and national research on waterfowl crossbred and studies on the growth and reproduction ability of mallard, 15-Dai Xuyen sea duck and Star 53 duck.

On the basis of analysis and evaluation on national and international results published, it has been shown that in recent years, the direction of pure breeding selection to create high-performance duck lines at the same time as crossbreeding, taking advantage of heterosis to produce meat in order to meet market demand is still popular in many countries. Since the past few decades, a series of crossbred studies have produced crossbreeding that are superior to pure duck lines, especially crossbreeding of different breeds and species that bring high

economic efficiency for farmers. Studies on conformation and production ability of mallard, 15-Dai Xuyen Sea duck and Star 53 duck have also been conducted in domestic and abroad to assess their production ability. However, there have been no studies to evaluate conformation and production ability of the above-mentioned two- and three-breed crossbreeding duck combination.

## **Chapter 2. MATERIALS, CONTENTS AND METHODS**

### **2.1. MATERIALS, PERIOD AND LOCATION**

#### **2.1.1. Materials**

- + Sea Duck 15 - Dai Xuyen (denoted as B),
- + Mallar (denoted as T)
- + Star Duck 53 (denoted as S)
- + Crossbred (BT, TB, SBT, STB).

#### **2.1.2. Period and location**

- Content 1: ducks raised for laying at Dai Xuyen Duck Research Center, Phu Xuyen district, Hanoi city from June 2017 to December 2018.

- Content 2: The experiment was arranged at Dai Xuyen Duck Research Center. Quality analysis of commercial duck meat was carried out at the Faculty of Livestock Production - Vietnam Academy of Agriculture. The experimental period was from May 2020 to September 2020.

- Content 3: BT ducks for laying and commercial SBT was carried out in 3 provinces: Dong Xuyen general husbandry cooperative, Tien Hai district, Thai Binh province (raised in water with salinity of 2‰); Mrs. To Thanh Thuy's family farm, Khanh Lac village, Nghia Ha commune, Quang Ngai city (raised in water with salinity of 3 - 10‰); Mrs. Van Thi Hong's family farm, Dong Rui commune, Tien Yen district, Quang Ninh province (raised in water with salinity of 21 - 30‰). The experimental period on BT laying ducks was from June 2018 to December 2019; on commercial SBT ducks was carried out from April 2021 to June 2021.

## 2.2. CONTENTS

Content 1: conformation and production ability of BT and TB crossbred duck.

Content 2: conformation and production ability of SBT and STB crossbred duck.

Content 3: Evaluation of production ability of BT and SBT ducks on reality.

## 2.3. METHODS

### 2.3.1. Content 1: conformation and production ability of BT and TB crossbred duck

B drum with T hen line was paired, and T drum with B hen was reversely paired following diagram:



Crossbred ducks in post coupling was collected, selectd and hatched for eggs to consider hatching. B and T duck also was coupled (♂ B x ♀ B, ♂ T x ♀ T) to produce B, T duck. The number of 1-day-age breeding ducks in each breed was 750 (150 males and 600 females), divided into 3 plots, each plot had 50 drums and 200 hens, repeat 3 times at the same time. The rate of male and female coupling was 1/5. Ducks were raised in captivity without water to swim. The experiment was laid out in a completely randomized design with 1 factor. Ducks were fed and raised according to the dual-use and egg-specializing duck rearing process of Dai Xuyen Duck Research Center.

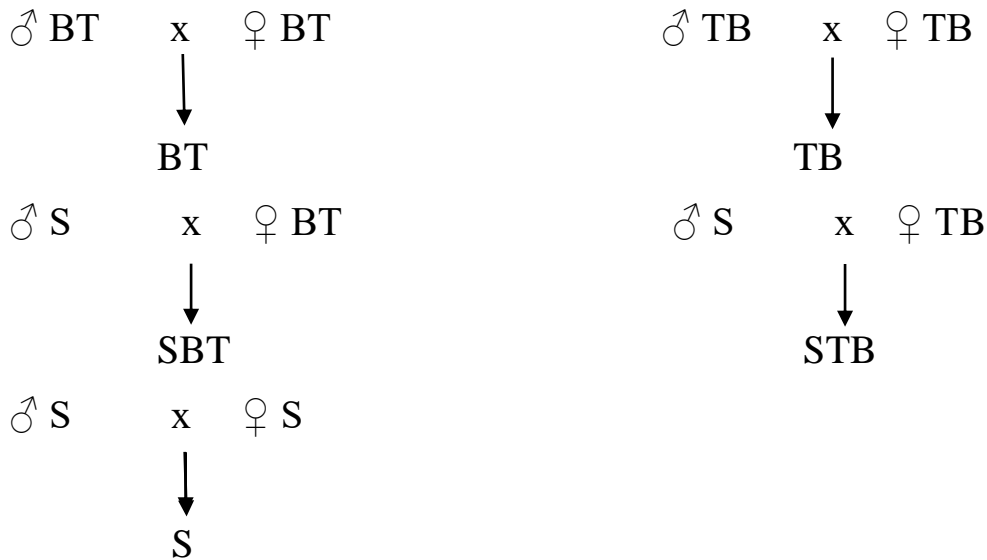
Evaluation of conformation and production ability of crossbred BT and TB ducks under the guidance of Bui Huu Doan et al. (2011).

### 2.3.2. Content 2: conformation and production ability of SBT and STB crossbred duck.



The experiment was completely randomized with 1 factor with 5 experimental plots of BT, TB, SBT, STB, S ducks at Dai Xuyen Duck Research Center. Each plot including 20 ducks (10 males and 20 females) repeat 5 times, total number of each plot was 100 ducks (50 males and 50 females) at 1-day age. The total number of experimental ducks at 1-day age was 500 (250 males and 250 females). Ducks were numbered from 1-day age and monitored until the end of 10 weeks of age, applied the commercial duck breeding process of Dai Xuyen Duck Research Center. Ducks were fed ad libitum with complete compound feed. Among the experimental plots, there was a similarity in care, nurturing, veterinary procedures for disease prevention, etc.

Commercial duck crossbred diagram:



*\*Characteristics of appearance and production ability of commercial three-variety SBT and STB hybrid ducks (Bui Huu Doan et al., 2011)*

### **2.3.3. Content 3: Evaluation of production ability of BT and SBT ducks in reality.**

BT ducks for laying (300 female ducks) and commercial SBT (300 ducks) were raised in 3 provinces of Thai Binh, Quang Ninh, Quang Ngai with different salinity in each province was arranged experiment at the same time, 1-day age ducklings provided by Dai Xuyen Duck Research Center, ducks were raised with controlled farming methods in ponds, pools and bays. The experiments at rearing sites were all carried out according to the caring process

of Dai Xuyen Duck Research Center with different in salinity and location factors.

Evaluation of production capacity of BT and SBT ducks outside of production according to the guidance of Bui Huu Doan et al. (2011). Selling price/kg, revenue-expenditure gap, economic efficiency indicators (Do Kim Chung et al., 1997).

#### 2.3.4. Data analysis

For all traceable indicators, statistical parameters (sample size, mean, standard error) were calculated using Excel 2016 software, Minitab 19.

\* Evaluate the influence of different breeds on the monitoring parameters by 1-factor analysis of variance.

Statistical model for one-way analysis of variance:

$$Y_{ij} = \mu + G_i + e_{ij}$$

where,  $Y_{ij}$ : value of the tracking indicator;

$\mu$ : population mean;

$G_i$ : influence of breed factor

$e_{ij}$ : random error.

\* Evaluation of the influence of 2 factors (breed and sex) on weight, daily weight gain over weeks of age, relative growth of ducks raised for meat in 5 experimental plots by 2-factor analysis of variance and the interaction between the two factors. Statistical model analysis of variance 2 factors and interaction between 2 factors:

$$Y_{ijk} = \mu + G_i + S_j + G_i*S_j + e_{ijk}$$

where:  $Y_{ijk}$ : value of the tracking indicator;

$\mu$ : population mean;

$G_i$ : influence of breed factor

$S_j$ : influence of gender factor

$G_i*S_j$ : interaction effect between gender factor and gender factor;

eijk: random error.

Compare the mean by Turkey, compare the percentages by  $\chi^2$  test, and analyze the effect by GLM (General Linear Model) using Minitab 19 software.

### **Chapter 3. RESULTS AND DISCUSSION**

#### **3.1. CONFORMATION AND PRODUCTION ABILITY OF BT AND TB CROSSBRED DUCKS**

##### **3.1.1. Conformation of BT and TB crossbred duck**

###### *Conformation*

Feather color of BT ducks and TB ducks at 1 day of age: pale yellow mixed with black, black felt on the head and tail, some birds have dark gray feathers with yellow dots on the back, black eye border. Vuong Thi Lan Anh (2020) said that the feather of 15 – Dai Xuyen sea duck was light yellow and black spots on the head, the tail accounted for the majority, the remaining part was a duck with jet black feathers and color. yellow, the feather of BT, TB ducks was darker than 15 – Dai Xuyen sea duck.

Adult ducks (38 weeks age): BT crossbred ducks had dark wing feathers, blue-black tips of feathers, some had dark black feathers running from the eyes to the top of the neck, favoring the mallard. Males had darker feathers than females. For TB crossbred ducks, the wing feather color was lighter than BT crossbred ducks, some had white cavity, blue-black wing feathers, some had dark black feathers running along from the eyes to the top of the neck in favor of 15 – Dai Xuyen sea duck feather color.

In terms of body, beak and legs: BT and TB crossbred adult had an elongated duck body, a long neck in favor of egg-oriented ducks, especially in BT crossbred duck, eyes were dark brown, bright, and fast. There was a clear difference between male and female ducks in conformation: the male had a larger body than the female, and the feather color was darker. The beak and legs were both yellow or greyish-yellow, some were blue-black.



**Figure 3.1. BT duck at mature**



**Figure 3.2. TB duck at mature**

*Sizes in some dimensions*

At 8 weeks of age, the chest circumference measurement of BT ducks was measured at 26.36 and 26.58 cm for males and 25.84 and 26.33 cm for females. The body length of the male duck was measured at 23.13 -23.27 cm and the female was 21.69 and 21.88 cm. At 38 weeks of age, the breast circumference of ducks reached 30.09 cm and 30.38 cm, respectively; 29.11 cm and 29.18 cm in males and females. VN/DT ratio of BT and TB ducks at 8 weeks of age was 1.14 - 1.15 respectively in males; 1.19 - 1.20 in the female. When ducks in mature at 38 weeks of age, this indicator was 1.14 - 1.15 in males and 1.21 in females, respectively. At 8 weeks of age, the breast length of crossbred duck in males and females was 11.46 - 11.67 cm and 10.21 - 10.79 cm, respectively, increased at 38 weeks of age to 12.43 - 12.78. cm in males and 11.26 - 11.81 cm in females. Wing feather length at 8 weeks of age of both treatments was 11.35 - 13.88 cm when raised to 38 weeks of age was 16.15 - 16.96 cm. The leg height of crossbred ducks at 8 weeks age was 6.92-7.20 cm, increased at 38 weeks was 7.03-7.63cm.

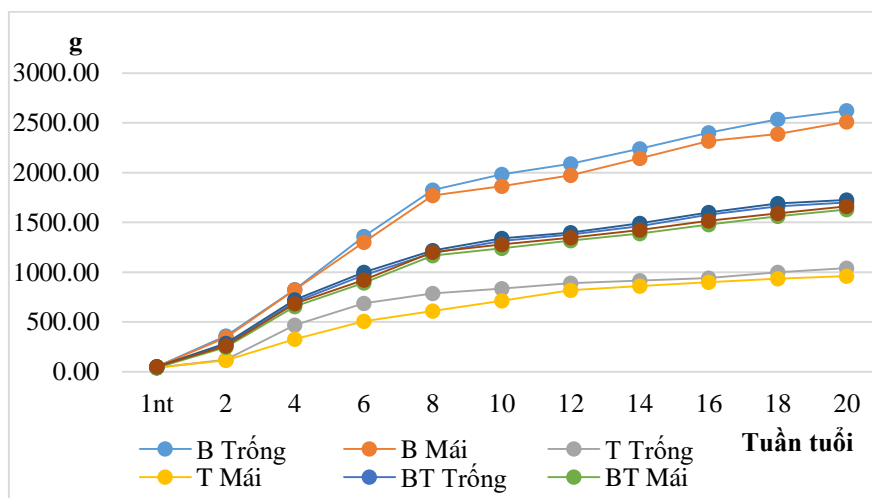
### 3.1.2. Production ability of BT and TB crossbred duck

#### 3.1.2.1. Survival rate

In the period of 1 day age - 8 weeks age, the survival rate of BT and TB crossbred ducks was 97.47 - 97.60%, equivalent to 97.73% ( $P>0.05$ ) and higher than ducks. 15 – Dai Xuyen sea duck was 96.53% ( $P<0.05$ ). The survival rate of BT and TB crossbred ducks at 9-20 weeks of age was 99.32%; for the whole period from 1 year to 20 weeks of age was 96.80 - 96.93%. The heterosis in survival rate of BT, TB crossbreeding ducks compared with broodstock through duckling stages (1st - 8 weeks age); gilting stage (9 - 20 weeks age) and duckling stage 1st to 20 weeks age are 0.34 - 0.48%; 0.21% and 0.55 - 0.69% in which heterosis in survival rate of BT duck was higher than that of TB duck.

#### 3.1.2.2. Body weight of laying ducks

At 8 weeks of age, the body weight of the BT male duck was 1193.70g, which was not significantly lower than that of the TB duck, which was 1217.40g ( $P>0.001$ ). At 20 weeks of age, the BT duck's body weight was 1701.10g, equivalent to that of the TB duck, 1727.40g. The line representing body weight of BT and TB ducks was quite close to each other, much higher than the line representing the body weight of mullar, the lowest was the line representing body weight of the mallard. On average, from 1 day age to 20 weeks age, the heterosis of BT and TB ducks was -7.14% to -4.2%.

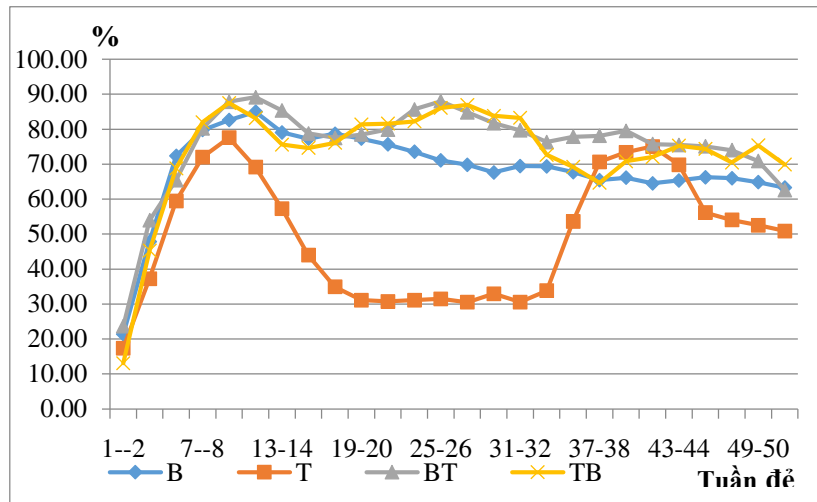


**Figure 3.4. Body weight of experimental ducks over weeks of age**

### 3.1.2.3. Age of sexual maturity and body weight at laying of breeding ducks

The laying age of TB, BT crossing ducks was 20-21 weeks earlier than that of sea ducks and mallard. The average weight at laying of BT hens was 1633.87; 1665.54 g; average body weight of male ducks was 1729.10; 1761.80g.

### 3.1.2.4. Laying rate



**Figure 3.5. Laying rate of experimental ducks through laying weeks**

Laying rate of BT and TB crossbred ducks was followed the general reproductive rules of waterfowl, relatively stable over 52 weeks of laying, and stable until the end of the cycle (laying week 52). The average laying rate of BT ducks was the highest (75.61%) followed by TB ducks (73.32%), with the same breeding conditions, laying rate of BT and TB ducks was higher than that of their parents.

### 3.1.2.5. Egg performance

Cumulative egg performance over 52 weeks of laying of BT ducks was the highest with 275.22 eggs/hen, lower than that of TB ducks with 266.87 eggs/hen, followed by Sea ducks with 250.23 eggs/hen and the lowest was a mallard with 178.83 eggs/hen ( $P < 0.05$ ). When sea duck crossbred with mallard gave super-dominance in terms of average egg performance/hen/52 weeks of laying: the dominant crossbred BT was 28.29% higher than the parents, the average crossbred ducks was 24.40 % compared to the average parent, the crossbred between the sea duck and the mallard had promoted a heterosis of the

parent in terms of egg performance, much higher than that of their parent. The BT duck gave a heterosis in terms of egg performance higher than that of the TB duck, promoting a higher heterosis compared to the TB duck.

#### ***3.1.2.6. Feed consumption/10 eggs***

Average feed consumption/10 eggs from 1 to 52 weeks of laying of BT duck was 2.20 and 2.28 kg lower than that of mallard and 15- Dai Xuyen Sea duck with 3.01 and 3,35kg ( $P < 0.05$ ). The crossbred ducks has promoted the heterosis in terms of feed consumption: the heterosis in terms of food consumption/10 eggs of BT crossbred duck, the average number of eggs from 1 to 52 weeks of laying was -30.82% and -28.30 %.

#### ***3.1.2.7. Rate of breeding eggs***

The rate of breeding eggs of BT duck was the highest level with 92.06%, followed by TB duck with 91.88%, followed by sea duck with 91.12% and finally mullar with 90.63% ( $P > 0.05$ ). Average rate of breeding eggs of BT, TB crossbred ducks for the whole period was from 1 to 52 weeks of laying, which was over 91.88%.

#### ***3.1.2.8. Some indexes of egg quality***

The average egg weight of BT and TB ducks was 70.94g; 71.61g higher than mallard with 54.87g and lower than sea duck with 82.83g ( $P < 0.05$ ). The morphological index of BT and TB crossbred eggs was 1.39 - 1.40, which was the average between sea ducks with 1.41 and mallard with 1.37; within the typical range of poultry eggs (1.36 - 1.43).

The egg quality indexes of BT and TB crossbred ducks were high and within the allowable range: Haugh unit of BT and TB crossbred ducks was quite high at 91.83 - 91.90; yolk index was 0.428 - 0.442; egg white index was 0.111 - 0.123; yolk ratio was 31.27-31.56%; the percentage of white was 56.66 - 56.98%; eggshell thickness was 0.418 - 0.432 mm. The BT yolk color of duck was a higher 13.90 than the TB duck (13.43).

#### ***3.1.2.9. Some hatching indexes***

**Table 3.11. Some hatching indexes of experimental ducks (n=3)**

Indexes	Unit	B		T		BT		TB	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
Embryonated egg rate	%	93.28 <sup>a</sup>	0.49	90.76 <sup>b</sup>	0.27	94.57 <sup>a</sup>	0.31	93.95 <sup>a</sup>	0.52
Hatching rate / embryonated egg rate	%	87.85 <sup>b</sup>	0.27	85.81 <sup>c</sup>	0.20	90.11 <sup>a</sup>	0.19	89.84 <sup>a</sup>	0.65
Hatching rate / total hatching eggs	%	81.94 <sup>b</sup>	0.68	77.88 <sup>c</sup>	0.41	85.22 <sup>a</sup>	0.13	84.40 <sup>a</sup>	0.15
Type I duck rate/number of hatched ducks	%	96.14 <sup>a</sup>	0.38	92.07 <sup>b</sup>	0.50	96.28 <sup>a</sup>	0.20	96.15 <sup>a</sup>	0.21

*Note: the numbers carrying different a,b,c letters are statistically different with  $P < 0,05$*

Hatching indexes of BT and TB crossbred ducks: Embryonated egg rate was 93.95 - 94.57%; Hatching rate/embryonated egg rate was 89.84 - 90.11%, Hatching rate / total hatching eggs was 84.40 - 85.22%; type I duck rate/number of hatched ducks was 96.15 - 96.28%.

## **3.2. CONFORMATION AND PRODUCTION ABILITY OF SBT AND STB CROSSBRED DUCKS**

### **3.2.1. Conformation of commercial SBT and STB crossbred duck**

#### ***Conformation***

SBT ducks: observed at 1 day of age, crossbred ducks had 4 feather color groups, accounting for 75% of their feathers were black and yellow (or yellow-black, chest and abdomen were light yellow), accounting for 13-15% of color. light yellow mixed with black feathers, 10% of ducks had black feathers all over the body, only 2% of ducks was light yellow feathers. When raising ducks to 56 days age (8 weeks age), there were 4 groups: black and white feathers (black and white, brown with white spots), sparrow feathers, black body feathers, pure white feathers; cocks had curved hooks at the head and tail; moderately large head, medium length neck; body intermediate between duck



specializing in meat and duck specializing in eggs, sharp eyes, flexible; The bill and legs are dark yellow, some are dark gray or yellowish gray.

STB ducks: 1-day- age ducks also had 4 groups of feather colors: black feathers with yellow (or yellow-black streaks, chest and belly were light yellow) accounting for 70%, light yellow mixed with black for 20%; Black body color accounted for 8%, light yellow body color accounted for 2%. Ducks at 56 days age still had 4 groups: black and white feathers (black and white streaks); sparrow feathers; pure white feathers; full body black feathers, males had curved hooks on the head and tail; moderately large head, medium length neck; large body in favor of meat production, sharp eyes, flexibility; The bill and legs were dark yellow, some were dark gray or yellowish gray.

#### *Sizes in some dimensions*

At 8 weeks of age: The breast circumference of SBT and STB ducks at 8 weeks of age was 32.31 - 32.46 cm in males and 31.31 - 31.44 cm in females; body length was 26.22 - 26.38 cm in males 25.78 - 25.91 cm in females. The ratio between breast girth and body length at 8 weeks of age of STB and SBT ducks was 1.23 in males and 1.21 in females, breast length was 12.39 - 12.43 cm in males and 12.17 in males and - 12.33 cm in the females; Wing feather length in males was 13.80 - 15.19 cm, in females was 14.44 - 15.23 cm, average leg height was 7.72 - 7.78 cm/duck and 7.51- 7.59 cm/duck.

At 10 weeks of age: chest circumference of SBT, STB ducks was 34.47 - 34.86 cm in males and 32.48 - 33.11 cm in females; body length was 27.74 - 27.85 cm for males and 26.54-26.81 cm for females. The ratio of bust/body length at 10 weeks of age of SBT, STB ducks was 1.24 - 1.25 for male ducks and 1.22 - 1.24 for female ducks; the keel length of the male duck was 13.76-13.84 cm longer than that of the hen, which was 13.21 - 13.25 cm; wing feather length was 17.87 - 18.23 cm in male ducks and 17.12 - 17.31 cm in female ducks; leg height was 8.03 - 8.12 cm/duck and 7.97-7.99 cm/female.

### **3.2.2. SBT và STB Production ability of SBT and STB crossbred duck**

#### **3.2.2.1. Survival rate**

The survival rate of SBT and STB crossbred ducks was high with 98-99%. The survival rate was highest in the BT and SBT formula (99%), lower than in the STB and TB formula, 98%, and the lowest was in the S duck formula with 96%. SBT, STB crossbred ducks with high vigor (over 98%) showed good adaptability to climate conditions and feeding process of Dai Xuyen Duck Research Center. SBT and STB hybrid ducks showed a heterosis in survival rate compared to the average of 1.03-1.54%, SBT crossbred ducks showed a crossbred ducks was heterosis in survival rate higher than STB ducks.

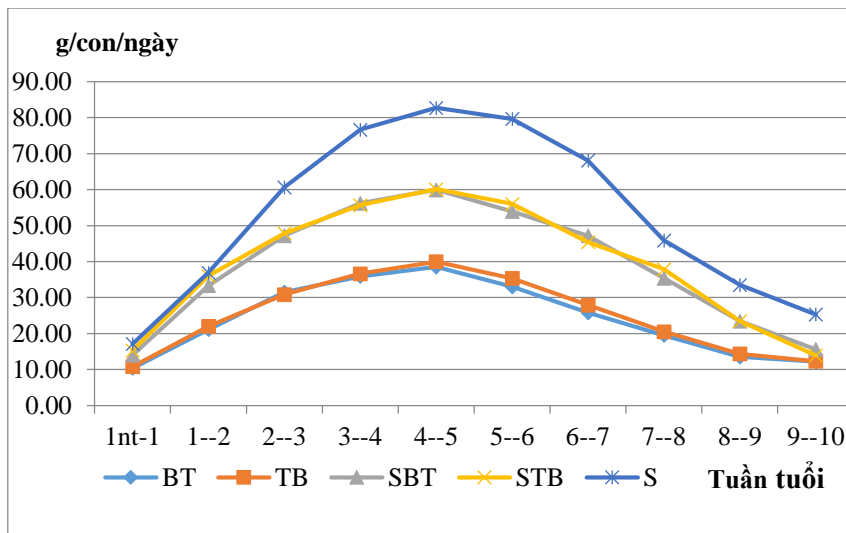
### ***3.2.2.2. Body weight of crossbred SBT và STB ducks over weeks of age.***

At 8 weeks of age, the body weight of SBT and STB ducks was 2480.00 - 2532.30g. Corresponding to 9 weeks age was 2636.20 - 2695.50g and 10 weeks age was 2746.30 - 2789.00g. The heterosis of crossbred SBT was a to average parent of 0.41% and higher than that of the STB duck (0.37%), the meat production capacity of SBT crossbred ducks as the same as that of the STB duck.

The effect of breed factor was certain on duck body weight over weeks of age (1 day age - 10 weeks age) with  $P < 0.0001$ . Meanwhile, gender had an effect on duck body weight at 3, 7, 8, 9, 10 weeks of age. The interaction between breed factor and gender only occurred at 1, 3 and 4 weeks of age. ( $P < 0.05$ ). Besides, the coefficient of determination was relatively high over weeks of age, the highest from week 7 to 9 was 91.66 - 92.44%, proved that the experimental arrangement was tight and the data had high reliability. .

### ***3.2.2.3. Absolute growth rate***

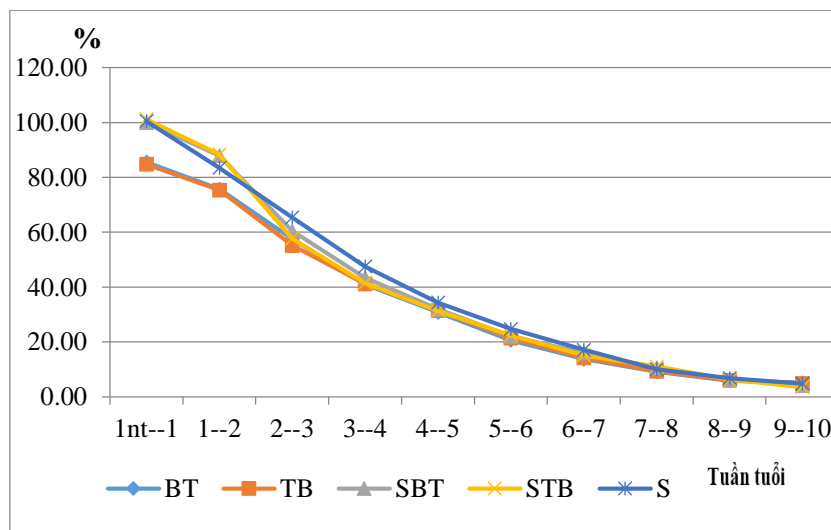
The absolute growth rate curve of ducks had a parabolic shape in accordance with the growth laws of poultry. In the average period from 1 day age to 10 weeks age, the absolute growth rate of SBT and STB ducks was 38.08-39.59g/duck/day which was higher than that of average and BT ducks with 24.29-25.16 g/duck /day and 52.50 g/duck/day lower than duck S ( $P < 0.05$ ). The absolute growth rates of SBT ducks and SBT ducks were similar ( $P > 0.05$ ).



**Figure 3.8. Absolute growth rate of commercial ducks over weeks of age (g/duck/day)**

At all stages from 1 day age to 10 weeks age, the difference in absolute growth of 5 different groups of commercial ducks was statistically significant with  $P < 0.0001$ . Statistically significant gender differences occurred from 5 to 10 weeks of age, interaction between breed and gender factors only occurred at 1nt - 1 week of age and 7-9 weeks of age. On average from 1 day age to 10 weeks age, the influence of breed and sex factors of experimental ducks was statistically significant at  $P < 0.0001$ ; There was no interaction effect between breed and gender on the absolute growth rate of ducks ( $P > 0.05$ ).

#### 3.2.2.4. Relative growth rate



**Figure 3.9. Relative growth rate of commercial ducks over weeks of age (%)**

The relative growth of 5-plot ducks followed the general law of relative growth in poultry with the form of a hyperbond line. The average relative growth rate of 1 day age - 10 weeks age of SBT and STB ducks was 39.01-39.79% higher than that of BT and average ducks at 35.47 - 35.64% ( $P < 0.05$ ) and not significantly lower than S duck with 41.29% ( $P > 0.05$ ). The relative growth rate of SBT and STB ducks was increased sharply from the first week of age, then decreased sharply and reached the lowest at 9, 10 weeks of age.

Breed factor (5 groups of ducks: BT, TB, SBT, STB, S) affected on the relative growth rate with  $P < 0.0001$  at most weeks of age except 8-9 weeks of age ( $P > 0.05$ ). The difference in relative growth rate between male and female was statistically significant at the stage: 1 day age - 1 week age; 5 - 9 weeks age. The interaction of breed and gender on growth was relatively statistically significant at the following stages: 1 day age - 1 week age; 6-7 weeks age, 8-9 weeks age ( $P < 0.05$ ).

The average period of 1nt - 10 weeks of age, the breed factor affected on the relative growth rate between groups of ducks at  $P < 0.0001$ ; The gender factor and the interaction between breed and gender factor did not affect the relative growth with  $P < 0.05$ .

#### **3.2.2.5. Food consumption/kg body weight gain**

At 1-day age - 8 weeks' age, feed consumption/kg body weight gain of STB, SBT (2.30kg) ducks was lower than BT, TB (2.50 - 2.51 kg) ducks, higher than that of ducks. S (2.13 kg). In the period from 1-day age to 9 weeks' age, the feed consumption/kg body weight gain of BT, TB, SBT, STB, S ducks was 2.74, respectively; 2.73; 2.46; 2.46 and 2.33 kg. At the end of the period 1-day age - 10 weeks' age, the feed consumption of 5 plots of BT, TB, SBT, STB, S was 2.96, 2.95; 2.69; 2.69 and 2.55 kg, respectively. Thus, at 3 age stages, the feed consumption/kg body weight gain of STB and SBT crossbred ducks was lower than TB, BT ducks and higher than S ducks.

### ***3.2.2.6. Meat production capacity of commercial ducks***

The carcass compositions of SBT crossbred ducks was comparable to those of STB ducks. At the time of slaughtering at 8, 9, and 10 weeks of age, SBT and STB ducks had quite high carcass composition ratios: carcass percentage was 69.56 - 71.91%, breast meat percentage was 17, 03 - 18.54%, the percentage of thigh meat was 10.56 - 13.20%, the total percentage of breast meat and thigh meat was 28.95 - 30.23%.

### ***3.2.2.7. Quality of commercial duck meat***

#### ***Physical composition of commercial duck meat***

The rate of dehydration during storage of breast meat was higher than that of thigh meat. The rate of dehydration due to preservation of breast and thigh meat of STB and SBT ducks at 8-10 weeks of age was 0.38 - 0.62% and 0.35 - 0.73%; The rate of dehydration during processing of breast and thigh meat in the period of 8 - 10 weeks of age in SBT and STB ducks was 23.50 - 28.50%.

The pH of thigh meat was higher than that of breast meat, the pH measured after 15 minutes slaughter was higher than the pH measured after 24 hours slaughter. The pH of SBT and STB ducks after 15 minutes slaughter at 8 - 10 weeks of age on breast and thigh meat were 6.24 - 6.36 and 6.34 - 6.45. The 24h post-mortem pH measurement of SBT and STB ducks at 8 - 10 weeks of age on breast and thigh meat was 5.50 - 5.68 and 5.90 - 6.03.

At 8-10 weeks of age, light color ( $L^*$ ) of breast and thigh meat SBT and STB was 37.87-40.49; 39.26-43.43. The red color ( $a^*$ ) on breast meat and thigh meat of SBT and STB hybrid ducks were both increased gradually from 8 to 10 weeks of age, thigh meat was darker red than breast meat. Breast meat at 8 weeks of age of SBT duck, SBT was 17.91 - 18.53, increased at week 9 to 18.14-18.81 and 10 weeks age was 20.57-20.71. This indicator on thigh meat of SBT duck, STB was 18.55-18.73 at 8 weeks of age, increased to 20.25-22.09 at 10 weeks of age. SBT duck meat had a lower yellow color than STB duck meat. Yellow color ( $b^*$ ) of SBT and STB in breast and thigh meat was 4.68 - 8.58, respectively; 5.40 - 9.49 at 8 - 10 weeks of age.

The toughness of breast meat and thigh meat of SBT and STB ducks was increased gradually with age, duck meat was most tough at 10 weeks of age. SBT and STB ducks had breast tenderness at 8-10 weeks of age, reaching 36.97-45.34, which was higher than that of S duck with 34.29-44.03, lower than BT duck, average of 36.05 - 51.22. Similarly, this indicator on SBT and STB duck thighs was 37.31-42.36, which was higher than that of S duck meat with 36.78-40.18 and lower than that of BT, average duck meat with 38.48-. 50.54.

### ***Chemical composition of commercial duck meat***

**Table 3.23. Chemical composition of commercial duck meat (%)**

Indexes	BT (n=6)	TB (n=6)	SBT (n=6)	STB (n=6)	S (n=6)
	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
CP	20.85±0.42	19.71±0.48	21.38±0.47	21.15±0.44	19.97±0.35
VCK	26.54 <sup>ab</sup> ±0.34	24.74 <sup>c</sup> ±0.40	26.39 <sup>ab</sup> ±0.30	26.70 <sup>a</sup> ±0.37	25.19 <sup>bc</sup> ±0.19
Ash	1.35±0.03	1.22±0.06	1.29±0.07	1.30±0.05	1.19±0.04
Lipit	2.22 <sup>ab</sup> ±0.10	1.20 <sup>c</sup> ±0.04	2.01 <sup>b</sup> ±0.09	2.36 <sup>a</sup> ±0.12	2.05 <sup>ab</sup> ±0.05

*Note: the numbers carrying different letters are statistically different with  $P < 0,05$*

The quality of breast meat, crude protein content of SBT duck analyzed was 21.38%, slightly lower than that of STB ducks at 21.15%. The dry matter content of STB and SBT ducks was 26.70; 26.39%. Ash content of SBT and STB ducks was 1.29; 1.30%. The lipid content in the breast meat of SBT and STB ducks is 2.01; 2.36%. The results of analysis of chemical components of STB and SBT duck meat were quite high in most of the criteria, and the lipid content in the breast meat of SBT duck was lower than that of STB duck.

## **3.3. EVALUATION OF PRODUCTION ABILITY OF BT AND SBT DUCKS IN REALITY**

### **3.3.1. Production ability of BT ducks in reality.**

#### ***3.3.1.1. Survival rate of BT ducks***

The survival rate of breeding ducks from 1 day age to 8 weeks age was highest in Thai Binh (97.67%) where salinity was 2‰, followed by Quang Ngai (97.00%) where salinity was 3-10‰ and the lowest was in Quang Ninh

(94.33%) where the highest salinity was 21-30‰ . In the gilt stage (9-20 weeks age), duck loss was low, the survival rate was over 97.17%. Both duckling and gilt stage (1nt - 20 weeks old) the survival rate of crossbred ducks was highest in Thai Binh at 95.33%, followed by Quang Ngai at 95.00% and finally in Quang Ninh was 91.67%. BT ducks raised in water with higher salinity, the lower the survival rate, the highest survival rate of BT ducks was raised in water with salinity of 2‰; Next to water environment with salinity 3 - 10‰ and lowest in water with high salinity 21 - 30‰.

### 3.3.1.2. *Body weigh of female BT duck*

**Table 3.25. *Body weigh of female BT duck (g/duck)***

Weeks of age	Thai Binh (n=30)			Quang Ngai (n=30)			Quang Ninh (n=30)		
	Mean	±	SE	Mean	±	SE	Mean	±	SE
1nt	47.33	±	0.33	47.20	±	0.45	47.57	±	0.24
4	681.17	±	9.11	663.20	±	10.20	655.67	±	9.51
8	1183.40 <sup>a</sup>	±	17.30	1179.40 <sup>ab</sup>	±	11.60	1134.60 <sup>b</sup>	±	11.70
12	1333.20	±	15.80	1326.30	±	19.10	1288.30	±	18.70
16	1497.10	±	20.50	1472.50	±	18.50	1432.30	±	19.20
20	1632.60 <sup>a</sup>	±	21.00	1625.50 <sup>ab</sup>	±	22.70	1552.10 <sup>b</sup>	±	21.90

*Note: the numbers carrying different letters are statistically different with  $P < 0.05$ .*

Body weight of female BT ducks at 8 weeks of age in Thai Binh, Quang Ngai and Quang Ninh was 1183.40; 1179.40 and 1134.60 g, respectively. Up to 20 weeks of age, the body weight of female BT ducks in Quang Ninh was 1552.10 g, lower than that of ducks raised in Quang Ngai at 1625.50g and in Thai Binh at 1632.60 g ( $P < 0.05$ ). Ducks raised in Quang Ninh had a salinity of 21 - 30 for the lowest body weight, followed by ducks reared in Quang Ngai with a salinity of 3 - 10 for higher body weight and finally in Thai Binh with a salinity of 3 - 10. salinity 2‰ for body mass was the highest. Salinity  $\geq 20$  ‰ influenced to the body weight of BT hens.

### 3.3.1.3. *Some reproductive parameters of BT ducks.*

**Table 3.26. Some reproductive parameters of BT ducks**

Indexes	n	Unit	Thai Binh	Quang Ngai	Quang Ninh
Age of laying	-	week	20	19	20
Body weight of duck at laying	50	g	1630,63	1625,40	1567,07
Weigh of egg	50	g	70,34	70,56	70,22
Lossing rate (raising for laying)	-	%	2,10	2,46	2,55

The laying age of BT ducks was 19 - 20 weeks, in which laying age of ducks raised in Quang Ngai was earlier than those reared in Thai Binh and Quang Ninh, the weight of laying hens was 1567.07 - 1630.63 g with egg weight. reaching 70.22 – 70.56 g.

#### **3.3.1.4. Laying rate, egg performance of BT ducks**

The egg performance and laying rate of BT ducks raised in reality in Thai Binh and Quang Ngai (salinity <10‰) was higher than ducks raised in Quang Ninh (salinity 21-30‰). The average laying rate/52 weeks of laying was highest in Thai Binh at 76.80%, followed by Quang Ngai at 76.15% and finally in Quang Ninh at 74.38%, corresponding to egg performance /hen/ 52 weeks of laying of ducks raised in Thai Binh was the highest level of 279.57, followed by Quang Ngai with 277.20 and the lowest in Quang Ninh with 270.73.

#### **3.3.1.5. Food consumption/10 eggs of BT ducks**

The lowest feed consumption/10 eggs in Thai Binh was 2.16 kg, followed by Quang Ngai with 2.18 kg and the highest in Quang Ninh with 2.24 kg. The highest egg performance in Thai Binh, feed consumption/10 eggs was lowest and egg performance in Quang Ninh was lowest, feed consumption would be the highest.

#### **3.3.1.6. Preliminary efficiency of BT duck farming model**

Ducks raised for eggs with the number of 300 hens, calculated on the product obtained as commercial duck eggs with the selling price of 3,600 VND/egg, the preliminary accounting of economic efficiency was 184,765 VND - 220,911 VND per hen at the end of the period, the highest in the farming model in Thai Binh province, the lowest in Quang Ninh. If including



the cycle of high economic efficiency indicators, the profit obtained was 49,517,109 - 61,854,975 VND/300 hens after deducting all costs that obtained economic benefits to farmers, contributed to job creation.

### **3.3.2. Production ability of SBT ducks in reality**

#### **3.3.2.1. Some growth rate parameters of SBT ducks**

**Table 3.30. Some parameters of SBT raised in 3 provinces**

Indexes	Unit	Thai Binh	Quang Ngai	Quang Ninh
Number of ducks at the beginning of the period	duck	300	300	300
Number of ducks at the end of the period	duck	296	294	286
Survival rate up to 8 weeks age	%	98.67	98.00	95.33
Feed consumption/kg weigh gain	kg	2.32	2.30	2.34
Average body weight at 8 weeks age	kg	2.53	2.55	2.48

The survival rate up to 8 weeks of age of SBT ducks in Thai Binh got the highest level of 98.67%, followed by Quang Ngai with 98% and the lowest in Quang Ninh with 95.33%. Thus, the salinity of  $\leq 10\%$  ducks was better adapted to the low lossing rate. Average body weight up to 8 weeks of age was 2.48 - 2.55 kg/duck, consumed 2.30 - 2.34 kg/kg of weight gain.

#### **3.3.2.2. Preliminary efficiency of SBT duck farming model**

300 commercial ducks raised in 3 provinces with different salinity of water, the survival rate was over 95.33%, the costs of breeding stock, feed, veterinary medicine, electricity, water, labor with depreciation of the barn, the total revenue for each model of 300 commercial ducks was VND 29,789 - 31,487 million. From there, the difference between revenue and expenditure was calculated from VND 6,048 million to VND 7,243 million/model of 300 ducks, calculating interest/duck from VND 21,147 to VND 24,639. The commercial duck farming model in Quang Ngai brought the highest economic efficiency, followed by Thai Binh and the lowest in Quang Ninh.

## CONCLUSIONS AND RECOMMENDATIONS

### CONCLUSIONS

#### 1. Conformation and production ability of BT and TB crossbred ducks

*Conformation:* BT crossbred ducks had dark sparrow feathers, blue-black tips of feathers. Some ducks had dark black feathers running from the eyes to the top of the neck, favoring the mallard while the TB crossbred ducks had light colored feathers. than BT crossbred duck, some had white cavity, blue-black wing feathers, some had dark black feathers running from the eyes to the top of the neck, in favor of the feather color of 15 - Dai Xuyen sea duck.

*Production ability of BT and TB crossbred ducks* was higher than their parent with a super-dominant heterosis in terms of fertility: the survival rate until 20 weeks of age of crossbred ducks was 96.80 - 96.93%, the age of laying at 20-21 weeks of age, the weight at laying was 1628.90 - 1662.90 g/ female duck, 1701-1727g/male duck, egg performance was 266.87 - 275.22 eggs/hen/52 weeks of laying, consumed 2.20 - 2.28 kg of feed/10 eggs, egg weight was 70.94 - 71.61 g. The eggs achieved quality criteria were all high and within the range of breed egg standards. The egg hatching criteria were high.

#### 2. Conformation, production ability of SBT and STB crossbred duck

SBT, STB crossbred duck feathers had 4 groups: black feather color with white or black white streak, brown with white spots, color of wing feathers, color of black feathers on the whole body, and pure white feather color; intermediate body between ducks specializing in meat and ducks specializing in eggs; The bill and legs were dark yellow, some ducks were dark gray or yellowish gray.

The survival rate of SBT and STB crossbred ducks was high up to 10 weeks of age, 99 and 98%, respectively, with a heterosis of 1.54 and 1.03%, body weight was 2746.3g and 2789g with 0.41% and 0.37% heterosis, feed consumption/kg body weight gain was 2.69 kg, the carcass rate crossbred ducks was 71,91% and 71.55%, the percentage of breast meat was 18.43% and 18.54%; the percentage of thigh meat was 10.56% and 11.47% with a low belly fat rate of 1.67% and 1.30%. The

meat analysis criteria was within the allowable threshold, the toughness was suitable to the tastes of Vietnamese consumers.

### **3. Evaluation of production ability of BT and SBT ducks in reality.**

BT and SBT ducks raised for production in 3 provinces of Thai Binh, Quang Ngai and Quang Ninh achieved high results: body weigh at laying of BT ducks was 1567.07 - 1630.63 g/hen, laying age was 19 - 20 week age, egg performance was 270.73 - 279.57 eggs/hen/52 weeks of laying, consumed 2.16 - 2.24 kg feed/10 eggs, egg weight was 70.22 - 70.56g, accounting preliminary economic efficiency of profit/hen was 184,765 - 220,911 VND; SBT duck had a high survival rate of 95.33 - 98.67%, body weight for sale (8 weeks age) was 2.48 - 2.55 kg, consumed 2.30 - 2.34 kg feed/kg body weight gain, profit/duck/8 weeks age was 21,147 - 24,639 VND.

### **RECOMMENDATIONS**

Conduct selective research to improve productivity of BT crossbred ducks, transfer development to production.

Futher development of SBT commercial crossbred duck.