# Performance Test to Select Female Tegal Ducks Based on Production Characteristics

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**Abstract**. This study aims to determine the increase in production capacity through genetic quality improvement using selection techniques with the production capability test method in Tegal ducks. The research was conducted using an experimental method, using a nested pattern experimental design, male as treatment, female as sub-treatment, offspring as replicates, and production characteristics as observations. The selection population of Tegal ducks consisted of 10 males, 50 females, and their offspring. Production characteristics recorded included egg weight, hatching weight, and egg production. Egg production measured was Hen Day Production (HDP) at the initial laying period for 90 days. Assessment of genetic quality using individual breeding values (BV). Each individual's breeding value is calculated, and then the estimated breeding value (EBV) results are arranged based on their rank. Selection of parent candidates is done by maintaining 25, 50, and 75% of the total population. Selection results are obtained by estimating the selection response using different selection intensities. The results showed that the average and standard deviation of the characteristics of egg weight, hatching weight, and percentage of egg production in Tegal ducks were 67.76 ± 4.57 g, 40.40 ± 2.16 g, and 63.33 ± 10.89 %, respectively. Heritability values (h2) and standard error of egg weight characteristics, hatching weight, and percentage of egg production in Tegal ducks were 0.47 ± 0.032, 0.39 ± 0.0589, and 0.512 ± 0.071, respectively. The assessment for selection response was conducted based on three factors - egg weight, hatching weight, and percentage of egg production each week. The proportions were maintained at 25%, 50%, and 75%, respectively. The egg weight proportions were 0.46, 0.29, and 0.15, while the hatching weight proportions were 0.71, 0.45, and 0.23, respectively. The percentage of egg production each week was 47.92%, 30.18%, and 15.85%, respectively. The study's results revealed that the intensity of selection and selection response of the Tegal duck were higher when smaller proportions were used in the selection process. It should be noted that the production characteristics used in the selection process were different, which resulted in varying heritability values and selection responses. Overall, these findings suggest that careful consideration of the selection factors is necessary to achieve optimal results in the selection process of the Tegal duck.

**Keywords**: production ability test, selection, production characteristics, Tegal duck

**Abstrak**. Penelitian bertujuan untuk mengetahui peningkatan kemampuan produksi melalui perbaikan mutu genetik menggunakan teknik seleksi dengan metode uji kemampuan produksi pada itik Tegal. Penelitian dilakukan dengan metode eksperimen, menggunakan rancangan percobaan pola tersarang, pejantan sebagai perlakuan, induk sebagai sub perlakuan, anak sebagai ulangan dan karakteristik produksi sebagai pengamatan. Populasi seleksi itik Tegal terdiri atas 10 ekor pejantan, 50 ekor induk dan keturunannya. Karakteristik produksi yang dicatat meliputi: kemampuan produksi (bobot telur, bobot tetas dan produksi telur). Produksi telur yang diukur adalah Hen Day Production (HDP) pada periode peneluran awal selama 90 hari. Penaksiran mutu genetik menggunakan nilai pemuliaan (NP) individu. Setiap individu dihitung nilai pemuliaanya, kemudian hasil taksiran NP tersebut disusun berdasarkan peringkatnya. Pemilihan calon induk dilakukan dengan mempertahankan 25, 50 dan 75% dari total populasi. Hasil seleksi diperoleh dengan menaksir respon seleksi menggunakan intensitas seleksi yang berbeda. Hasil penelitian menunjukkan bahwa rataan dan simpang baku karakteristik bobot telur, bobot tetas dan persentase produksi telur pada itik Tegal masing-masing adalah 67,76 ± 4,57 g; 40,40 ± 2,16 g dan 63,33 ± 10,89 %. Nilai heritabilitas (h2) dan standar error karakteristik bobot telur, bobot tetas dan persentase produksi telur pada itik Tegal masing-masing adalah 0,47 ± 0,032; 0,39 ± 0,0589 dan 0,512 ± 0,071. Penaksiran respon seleksi berdasarkan bobot telur dengan proporsi yang dipertahankan sebesar 25%, 50% dan 75% masing-masing sebesar 0,46; 0,29; 0,15, bobot tetas dengan proporsi yang dipertahankan sebesar 25, 50 dan 75% masing-masing sebesar 0,71; 0,45; 0,23 sedangkan persentase produksi telur per minggu masing-masing sebesar 47,92%; 30,18%; 15,85%. Disimpulkan bahwa proporsi yang digunakan dalam seleksi semakin sedikit, maka intensitas seleksi dan respon seleksi yang dihasilkan semakin besar. Karakteristik produksi yang digunakan dalam seleksi berbeda maka nilai heritabilitas dan respon seleksi yang diperoleh juga berbeda.

**Kata kunci**: uji kemampuan produksi, seleksi, karakteristik produksi, itik Tegal

## Introduction

Indonesia is renowned for its high biodiversity, which includes a diverse range of livestock, such as ducks. Most of the duck population in Indonesia is concentrated on the island of Java and the western Indonesian archipelago. The country boasts various breeds of local ducks, including Cirebon, Mojosari, Alabio, Tegal, and Magelang. With immense potential, Indonesian ducks are a significant producer of meat and eggs.

The government's efforts to support the livestock sub-sector program, which aims to increase livestock production, can be achieved in two ways. Firstly, by increasing the livestock population, and secondly, by improving the genetic quality of livestock (Sari et al., 2012). To enhance the genetic quality of livestock, selection and mating systems can be employed. By directing these systems towards forming populations with better genetic quality, an increase in the appearance of production traits can be observed (Prasetyo and Susanti, 2007). However, the breeding of ducks has not yielded optimal results so far, as the selection of ducks to be used as seeds is solely based on phenotypic properties, rather than their breeding value. Therefore, breeders must record and select ducks based on breeding values, so that the genetic abilities of each individual can be increased (Suhada et al., 2009).

The process of selecting ducks for breeding is based on their phenotypic value and high breeding value (Falconer, 1983). The aim is to improve the genetic quality of the population by estimating breeding values that are influenced by heritability values (h2) and the difference between the average selected elders and the average population of early generations (Warwick et al., 1995). The success of selection is measured by the increase in production, particularly in terms of the responsiveness and accuracy of selection. This increase is reflected in the selection response (R), which represents the genetic enhancement of ducks. The selection response is often symbolized by G, where a change (Δ) occurs in the genetic value (G).

Production characteristics play a crucial role in selecting genetically superior ducks, given their significant contribution to meeting the nutritional needs of the community, especially in national meat and egg production. The growth rate and egg production are two key factors that are improved by selecting individuals with above-average growth rates and egg production.

Based on this background, it is important to conduct research on production capability testing as a basis for selection in Tegal ducks. This requires identifying production characteristics to calculate the breeding value. Examples of the production characteristics that can be used as a basis for selection are egg weight, hatching weight, and percentage of egg production.

## Materials and Methods

The research was conducted using an experimental method that employed analysis of variance (ANOVA) with a nested pattern experimental design, where male was considered as the group, female as the sub-group, offspring as the replication, and production characteristics as the observation. The selection population of Tegal ducks consisted of 10 males, 50 females, and their offspring. Production characteristics recorded included production capability (egg weight, hatching weight, and egg production). Egg production measured was Hen Day Production (HDP) during the initial laying period of 90 days. Assessment of genetic quality was carried out using individual breeding values (BV). Each individual's breeding value was calculated, and the BV estimation results were arranged based on their rank. Selection of parent candidates was done by maintaining 25%, 50%, and 75% of the total population. Selection results were obtained by estimating the selection response using different selection intensities.

Selection is carried out using individual production records by the method of individual selection.

Mathematical Model: Yijk = μ + Pi + I $(Pi)_j$ + Eijk (Becker, 1992)

Yijk = result of measuring production characteristics k from female j on male i
M = median value of the population
Pi = influence from male to i
I $(Pi)_j$ = influence of the j-th female on the i-th male
Eijk = random effect or measurement error on characteristics production to k from brood to j in males to i

The estimation of the value of the coefficient of inheritance or heritability value (h2) is carried out by the formula *Paternal Coefficient Halfsibs* (father's half-sib component) based on Becker's (1992) instructions.

The formula used is:

$$h^2 = \frac{4\sigma^2 P}{\sigma^2 A + \sigma^2 l + \sigma^2 P}$$

(Becker, 1992)

h2 = heritability of production characteristics
σ2P = male variance component
σ2l = female variance component
σ2A = offsring variance component

Estimation of parental breeding value (BV) using path coefficient diagrams:

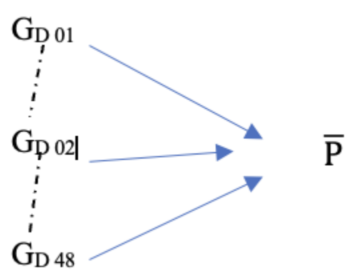


Figure 1. *Path Coefficient* Diagram Description:

$G_D$ 01 = parent number 1
$G_D$ 02 = parent number 2
$G_D$ 50 = parent number 50
$h_2$ = heritability
$P_{D\,01}$ = individual production number 1 (egg weight, hatching weight, and egg production)
$P_{D\,02}$ = individual production number 2 (egg weight, hatching weight, and egg production)
$P_{D\,50}$ = individual production number 50
$\underline{P}$ = population mean production

Calculation of Breeding Value (BV):

$$BV = h^2(P - \underline{P})$$

Description:

BV = calculation of Breeding Value
$h^2$ = heritability of egg weight, hatching weight, and egg production
P = individual production i
$\overline{\mathrm{PP}}$ = population average production

The estimation of the selection response was obtained before determining the selected individuals, but the proportion of retained parents was known. The proportion of broodstock that is maintained is 25%, 50%, and 75% of the total population. The selection response was calculated using the following formula:

$$R = h^2 \, x \, i_{mp} \, x \, \sigma_p$$

Description:

R = selection response
$h^2$ = heritability of egg weight, hatching weight, and egg production
$i_{mp}$ = mid-parent selection intensity
$\sigma_p$ = standard deviation of the phenotype

## Results and Discussion

The characteristics of egg weight, hatching weight, and egg production in Tegal ducks (F0) are shown in Table 1. Egg weight is the weight obtained from weighing the collected eggs, hatching weight is the weight obtained from the weighing results of Day-Old Duck (DOD) which hatches after 24 hours or when DOD feathers have dried. The egg production measured was HDP at the initial laying period of 90 days. The mean and standard deviation characteristics of egg weight, hatching weight, and egg production in Tegal ducks are presented in Table 1.

Based on Table 1, there were indications that the characteristics of egg production in Tegal ducks are relatively diverse. This can be seen from the value of standard deviation. Egg weight is associated with age and production cycle. The egg weight and hatching weight of Tegal ducks obtained in this research were higher than that of Pegagan ducks in South Sumatra, with a result of 36.37 ± 3.89 g and 65.32 ± 3.81 g (Sari et al., 2012). They were also relatively smaller than native Chinese ducks with the value of 70.84 ± 7.82 g (Xue et al., 2013). Mojosari duck egg weight is 60.83 g (Yulianti et al., 2015). Dewanti et al. (2014) reported that the average hatching weight of local ducks was 38.59-46.44 g from 53 - 60 g and 69 -76 g egg weights, and Magelang ducks were 41.7 ± 3.09 g (Lestari et al., 2013). According to Onbasilar et al. (2011), several factors that contribute to production characteristics are environment, genetics, nutrition, and production cycles.

Several studies on the production of native and crossbred duck eggs in Indonesia have been reported. The egg production of Mojosari-Alabio (MA) crosses per year is 69.4%. Shepherd ducks are only at 26.9 – 41.3%, and caged ducks are at 55.6% (Ketaren and Prasetyo, 2000). The egg production of Alabio-Pekin (AP) and Pekin-Alabio (PA) molting crosses was 52.36% – 71.13% and 60.21% – 79.47%, respectively (Susanti et al., 2012). Mallard ducks in the Philippines with black, brown, dark brown, and light brown fur had egg production of 83.96%, 76.68%, 77.51%, and 74.76%, respectively (Datuin and Magpantay, 2013). Different results are thought to be due to differences in species, population size, time, and place of measurement.

Hatching weight is influenced by the body weight of the parent and egg weight. The body weight of the parent can determine the weight of the eggs produced. The average body weight of the Tegal ducks was 1210.15 ± 95.17 g, while the average egg weight was 67.76 ± 4.57 g/grain. According to Wardono et al. (2014), the correlation coefficient value between parent body weight and egg weight is 0.0478, meaning that egg weight was positively correlated with the body weight of the parent. The higher the body weight of the parent, the higher the egg weight produced. In addition to being influenced by the body weight of the parent and egg weight, hatching weight is also influenced by other factors such as the temperature and humidity of the incubator. The temperature and humidity of the incubator at the time of the study were 38ºC and 70%. Melyanti et al. (2012) stated that the normal temperature and humidity are 38-39ºC and 60-70%. Temperatures that are too high and humidity that is too low can cause hatching weights to decrease due to dehydration during the hatching process.

The weight of the eggs used for hatching is 59-70 g. The smallest eggs, tagged T1-3 and T4-2, with a weight of 59 g, had hatching weights of 43 and 40 g. The largest egg, weighing 70 g, was tagged T1-4 and T2-4 and had hatching weights of 46 and 47 g. According to North and Bell (1990) which state that eggs that are light in weight will produce chicks that are light at hatching compared to those from heavier eggs. This is because larger eggs contain more nutrients than smaller ones. Information on the egg production capacity of local ducks varied. Chavez and Lasmini (1978), cited by Resi (2009), reported that Tegal ducks had a higher egg production ability than Mojosari ducks, Bali ducks, and Alabio ducks, which had egg production percentages of 53.41%, 58.6%, and 56.78%, respectively. Hardjosworo et al. (1989) reported production of Tegal ducks was lower than that of Mojosari ducks, but the production of Bali ducks higher.

Table 1. Mean and standard deviation of egg weight, hatching weight and egg production in Tegal ducks (F0)

| Characteristics | The mean and standard deviation |
|---|---|
| Egg weight (g) | 67.76 ± 4.57 |
| Hatching weight (g) | 40.40 ± 2.16 |
| Egg Production (%) | 63.33 ± 10.89 |

Tabel 2. The average egg weight, hatching weight, and egg production characteristics of Tegal ducks (F0) were selected with different proportions

| information | Proportion of Selected Parent (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Egg Weight (g) | | | Hatching Weight (g) | | | Egg Production (%) | | |
| | 25 | 50 | 75 | 25 | 50 | 75 | 25 | 50 | 75 |
| Number of livestock selected (heads) | 13 | 25 | 37 | 13 | 25 | 37 | 13 | 25 | 37 |
| $\underline{P}$ Parent selected | 80.47 | 75.90 | 71.33 | 46.88 | 44.72 | 42.60 | 92.14 | 83.11 | 74.22 |

Information: $\underline{P}$: Selected parent production average

**Selection of Tegal Ducks (F0)**

The selection of broodstock in this study used a production capability test based on the BV of egg weight, hatching weight, and egg production. The proportions of broodstock that were maintained were 25%, 50%, and 75% of the total population, or 12, 24, & 36 individuals, respectively. Average selected parent candidate's (F1) presented in Table 2.

The average performance value of hatching weight and weight at four weeks of age, while maintaining a proportion of 25%, is higher than that of the proportion of 50% and 75%. This is because the lower the number of ducks selected, the higher the average performance. Hardjosubroto (1999) stated during selection process, livestock with performance above the predetermined population performance will be selected first, while livestock with lower performance than the specified population will be removed. Therefore, the average performance value of the selected livestock is higher than before selection.

**Assessment of response or selection results of Tegal ducks (F0)**

The selection response was calculated based on production data from the selected parent candidates, comprising 25%, 50%, and 75% of the population. The results of the selection response assessment are presented in Table 3.

The heritability values (h2) and standard error of egg weight characteristics, hatching weight, and percentage of egg production in Tegal ducks were 0.47 ± 0.03, 0.39 ± 5.89, and 0.51 ± 0.07, respectively (Purwantini et al., 2015).

Table 3. Assessment of response or selection results in Tegal duck broodstock (F0)

| Maintained parent proportions (%) | Parent rank maintained | Mid parent selection intensity ($i_{mp}$) | Selection Response on Characteristics | | |
|---|---|---|---|---|---|
| | | | Egg Weight (g) ($h^2_{BT}$. $i_{mp}$ . $\sigma_{pBT}$) | Hathcing Weight (g) ($h^2_{BB}$ . $i_{mp}$ . $\sigma p_{BB}$) | Egg Production (%) ($h^2_{BB}$ . $i_{mp}$ . $\sigma p_{BB}$) |
| 25 | 1 – 13 | 0.64 | 0.46 | 0.71 | 47.92 |
| 50 | 1 – 25 | 0.40 | 0.29 | 0.45 | 30.18 |
| 75 | 1 – 37 | 0.21 | 0.15 | 0.23 | 15.85 |

Information: $h^2BT$ : heritability of egg weight; σpBT: standard deviation of egg weight; $h^2BT$: heritability of hatching weight; σpBT: standard deviation of hatching weight; h2BT: heritability of hatching weight; σpBT: standard deviation of egg weight; imp: mid parent selection intensity

Selection response assessment was based on egg weight, with the proportions maintained at 25%, 50%, and 75%, resulting in 0.46, 0.29, and 0.15, respectively. Hatching weight with maintained proportions of 25%, 50%, and 75% were 0.71, 0.45, and 0.23, respectively. Meanwhile, the percentage of egg production each week was 47.92, 30.18, and 15.85.

Based on Table 4, there are indications that if the proportion of livestock retained in the selection decreases, the intensity of the resulting selection will be greater. The response of egg production selection was higher than that of egg weight and hatching weight. This is because the heritability of egg production, 0.51 ± 0.07, is higher than the heritability of egg weight, 0.47 ± 0.03, and hatching weight, 0.39 ± 5.89. Warwick et al. (1995) stated that the estimation of the selection response value was influenced by the heritability value (h2), selection intensity (i), and phenotypic standard deviation (σp). The optimal selection response can be obtained by simulating the value of the intensity of the selection of male or female livestock that will be used as parents in the next generation.

## Conclusions

Based on the results of the study, it can be concluded that the smaller the proportion used in the selection, the greater the intensity of the selection, and the resulting higher selection response. The production characteristics used in the selection were different. Therefore, the heritability values and selection responses obtained were also different.

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