Heterosis Value Estimation of Hatching Weight and Growth Characteristics of Reciprocal Crossing Tegal and Magelang ducks

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ABSTRACT

The aim of this research is to estimate heterosis value of hatching weight and growth characteristic of reciprocal crossing Tegal and Magelang ducks. The cross between the male Tegal and female Magelang ducks is called Gallang (F1) and the cross between male Magelang ducks and the Tegal female is called Maggal (F1). The research material are 325 ducks consisted of Tegal and Magelang ducks with 8 males and 48 females each, also the reciprocal cross result of 112 Gallang ducks and 101 Maggal ducks. Research method is experiment. T test is used to determine the difference of the hatching weight, the weight of eight-week age, and the growth until the age of eight weeks between Maggal and Gallang ducks. The heterosis value is obtained by comparing the ability of the cross with the parent. This research has shown no heterosis in hatching weight whether in Gallang ducks (-4,94) or Maggal ducks (-11,72). The hatching weight of Gallang ducks (43.07 ± 4.77 g) was not significantly different from Maggal ducks (40.33 ± 2.89 g) and both were lighter than Tegal ducks (44.19 ± 4.77 g) and Magelang ducks (46.43 ± 4.37 g). In relative growth there wasn't good heterosis in Gallang ducks (-2.13) and Maggal ducks (-6.38). The relative growth of Gallang ducks (0.23 ± 0.016) did not differ significantly with Maggal ducks (0.22 ± 0.012) and both were lighter than Tegal ducks (0.23 ± 0.003) and Magelang ducks (0.24 ± 0.002). Heterosis was not significant in the weight of eight-week age of Maggal ducks (-4.90), but exhibit a positive value in Gallang ducks (1.60). The conclusion of this study is the positive heterosis value in weight of eight-week age in Gallang ducks showed that it can be expected to be broiler ducks.

Keywords: Heterosis, Hatching weight, Growth, Reciprocal crossing, Tegal and Magelang ducks.

INTRODUCTION

Duck egg and meat demand is increasing each year along with animal protein need. One of the efforts to meet the demand is to obtain prime duck with good production performance and growth. Prime duck is yielded from reciprocal crossing of specific male and female parents. The crossing of different genotypes can be done across strains, family and breeds that is generally performed as production strategy to utilize prime hybrid named as heterosis (Falconer dan Mackay, 1996; Noor, 2008). Heterosis is a phenomenon where the score of the inbred or purebred offspring is equal to or above the average of both population (Pirchner, 1969). One of the crossing methods is reciprocal, which is an opposite crossing where both parents act as the male in one crossing and as female in another (Hardjosubroto, 1999). According to Welsh (1991), repeated reciprocal selection improve the ability of both specific and general combination by selecting two populations simultaneously.

Tegal and Magelang ducks are specific local ducks from Central Java as the potential poultry commodity producing eggs and meat. Different performance and appearance between the local ducks are generally based on body shape and feather color. Tegal ducks has small performance thus difficult to improve although selected as a good meat producer, while Magelang ducks has a relatively bigger body than Tegal ducks. Purwantini *et al*. (2015) reported that Tegal ducks has a higher potential to produce egg than that of Magelang with the values of 66.41 ± 12.84 % and 65.08 ± 11.80%, respectively, while Magelang ducks has a higher body weight at early production than that of Tegal ducks, with the value of 1612.18 ± 122.74 g and1392.74 ± 117.99, respectively.

Different potential excellence of Tegal and Magelang ducks needs to be combined in reciprocal crossing to obtain offspring (F1) with a more excellent growth and egg production percentage, thus a higher economic value. Improving the genetic of poultry through selection may take a very long time, therefore reciprocal crossing and selection will accelerate genetic management by using heterotic effect (Munisi *et al.,* 2015).

Production characters to measure the excellence are hatching weigh and growth as the quantitative properties of performance. Taha and Ghany (2013) stated that diverse growth in poultry is contributed to different body weight (BW) and relative growth rate (RGR) according to Broody (1945).

Other study on heterosis value of local ducks reciprocal offspring in Indonesia has been reported of Tegal and Alabio duck crossing (Hetzel, 1983) and Mojosari and Alabio duck (Prasetyo dan Susanti, 2000). However, heterosis value of hatching weight and growth of the offspring of reciprocal crossing Tegal and Magelang ducks is limitedly published.

This research was aimed to estimate heterosis value of hatching weight and growth characteristics of reciprocal crossing Tegal and Magelang ducks. Crossing of male Tegal ducks and female Magelang ducks is called Gallang (F1) and the crossing of male Magelang ducks and female Tegal ducks is called Maggal (F1).

MATERIALS AND METHODS

The experimental study used 325 ducks consisted of Tegal and Magelang ducks with 8 males and 48 females each, and the reciprocal cross result of 112 Gallang ducks and 101 Maggal ducks. Mean and standard deviation was calculated then compared the hatching weight, 8-week old weight and the growth up to eight weeks on Gallang ducks (F1) and Maggal ducks (F1) with one sample t-test. The observed ducks were kept under uniform management. Hatching weight is the weight of *Day Old Duck* (DOD) after the feather dried. Scaling the hatching weight was performed while the dod's feathers dried for 24 hours. Growth was measured from the weight gain during 8 weeks.

Observation data were analysis using mean and standard deviation formula according to Steel and Torrie (1998) as follows:

Mean: $\overline{Y} = \frac{\sum_{i=1}^{N} Y_i}{N}$ Standard deviation: $Sd_Y = \sqrt{\frac{\sum (Y_i - \overline{Y})^2}{N-1}}$

Where $\overline{Y}$ = mean sample Y, Y_i = quantitative characteristics of i-individual, N = total sample, Sd_y = standard deviation of sample Y

One sample t-test was used to evaluate the value of a sample with certain value (as comparator). T-test was performed to calculate t-statistic value according to Steel and Torrie (1998) as follows:

$$t = \frac{\overline{Y_1} - \overline{Y_2}}{Sd\sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}$$

Where $\overline{Y_1}$ = mean of sample Y1, $\overline{Y_2}$ = mean of sample Y_2 as comparator, Sd = standard deviation of population, N_1 = total sample 1, N_2 = total sample 2

Heterosis value was obtained by comparing the performance of offspring and the parents in the crossing. All studied and measured parameters were subjected to estimation of heterosis percentage calculation according to (Adnan, 2003) using the following formula:

$$Heterosis\%(H\%) = \frac{\mu F1 - (\frac{\mu p1 + \mu p2}{2})}{(\frac{\mu p1 + \mu p2}{2})} x100$$

Where μF1 = the mean of the first generation of the crossbred line, μp1= the mean of the first purebred parent and μp2 = the mean of the second purebred parent.

RESULTS AND DISCUSSION

Production performance. Result showed mean and standard deviation of hatching weight, 8 week weight and relative growth characteristics of Tegal ducks, Magelang ducks and the F1 reciprocal crossing result (Gallang and Maggal), as presented in Table 1.

Table 1. Mean and standard deviation of hatching weight, 8 week body weight and relative growth characteristics of Tegal, Magelang, Gallang and Magal duck

Characteristics	Mean and standard deviation			
	Tegal (F0)	Magelang (F0)	Gallang (F1)	Maggal (F1)
Hatching weight (g)	44.19 ± 4.77^{ns}	46.43 ± 4.37^{ns}	43.07 ± 4.77^{ns}	40.33 ± 2.89^{ns}
8 week body weight (g)	1130.70 ± 189.09	1327.7 ± 92.10	1313.40 ± 143.86^{a}	1082.09 ± 228.96^{b}
Relative growth	0.23±0.003 ^{ns}	0.24± 0.002 ^{ns}	0.23±0.016 ^{ns}	0.22 ± 0.012 ^{ns}

Note: Values bearing superscript within rows shows significant difference based in t-test

Table 1 shows that the statistic value of hatching weight characteristics is not significantly different (P>0.05), but Gallang and Maggal ducks are lighter than either Tegal or Magelang ducks. The lighter hatching weight of the crossbred (F1) may be affected by the weight of hatching egg. Jull (1982), stated that hatching weight is approximately 70% of the egg weight. The higher the egg weight, the higher the hatching weight. Hen with big body weight will produce big egg, and vice versa (Etches, 1996).

Prasetyo *et al*. (2004) reported that the average hatching weight of the third generation male and female Albino duck was 43.0 g and 42.7 g, respectively, and of male and female Mojosari duck was 44.1 g dan 44.8 g, respectively. Hatching weight was affected by genetics, age, breeds, hen's body weight and total egg production. Selection on hatching weight of the offspring as the future strain will affect weekly body weight gain (Suparyanto, 2005).

Growth characteristic is not significantly different (P>0.05) in statistics result but Magelang ducks belongs to high category with relatively low standard deviation. The high relative growth in Magelang ducks is partly affected by hatching weight which plays an important role in body weight up to 8-w due to positive correlation between hatching weight and body weight at 4 and 8-w old.

Body weight of 8-w Gallang ducks is significantly different (P<0.05) from that of Maggal that may be affected by hatching weight and growth. Ismoyowati (2014) reported a positive correlation between hatching weight with 8-w body weight with the value of r = 0.649.

Heterosis value. Estimated heterosis value of hatching weight, 8-w body weight and relative growth characteristics of Gallang and Maggal ducks is presented in Table 2.

Table 2. Estimated heterosis value of hatching weight, 8-w body weight and relative growth of Gallang and Maggal ducks

Characteristics	Estimated heterosis value (%)	
	Gallang (F1)	Maggal (F1)
Hatching weight (g)	-4,94	-11,72
8-w body weight (g)	1,60	-4,90
Relative weight	-2,13	-6,38

Table 2 shows there is no heterosis in hatching weight of both Gallang (-4,94) and Maggal (-11,72), nor in relative growth of Gallang and Maggal with the value of -2,13 and -6,38, respectively. Heterosis is not significant in the weight of 8-w Maggal ducks (-4,90), but positive in Gallang ducks (1,60). The absence of heterosis in hatching weight and relative growth of crossbred Tegal and Magelang ducks could be because the characteristics are controlled by additive gene. Pirchner (1969) reported that the cause of heterosis is the non-additive gene (domination, over-dominance and epistasis). There is no observed heterosis for the characteristics that are controlled by additive gene action. Heterosis can occur for various performance characteristics. The heterosis-bearing traits is called heterotic traits. Lalev *et al*., (2014) obtained heterosis value of age at first laying egg and egg production was above 10% from crossing Gaoyou and Jinding in China, while 8-w body weight was 6.38% and the average egg weight was -1.67%. Sheridan (1980) stated that in most cases, hybrid ability could be due to dominant gene effect.

CONCLUSIONS

The positive heterosis value in weight of eight weeks age in Gallang ducks showed that it can be expected to be broiler ducks.

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