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Genetic Parameters of Birth Weight, Litter Size in Crossbreeding of Boer and Indonesian Goat

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Abstract: *The study was conducted to analyze the genetic crossbreed of Boer and PE goats through the productivity of offspring by crossing based on birth weight and litter size. The material used is 65 goats from the Boer and PE goats consisting of males and females. Data analysis was estimated by calculating the probability of birth weight, litter size using the average and standard deviation based on Noor (1996) formula, then this data was analyzed using the t-test based on Steel and Torrie, (1991) to find out its significance. The results of crossing Boer and PE goats have a high productivity and proliferation rate with an average birth weight parity of male goats parity higher than female goats were 3,92±0,59 dan 3,87±0,90 (P<0,05). The results of the sex ratio of female goats were on average higher than males were 45.73% and 54.27%, respectively. The sex ratio of males is higher than females only in the third parity (64.29% and 35.71%). The average yield of litter size of mothers who gave birth single, twins, and triplets (25%, 50%, and 25%). The results generally indicate that the litter size of the mother goat gave birth to twins and triplets by 80% and only 20% single. The highest litter size was at the fourth parity and the second parity (2.14 ± 0.11 and 1.86 ± 0.07 tails). The crossing of Boer and PE goats in the fourth parity has a high prolific rate. Goats with a fourth parity that are born with twin birth types and high birth weight can potentially have good genetic and could be used as stock prospective livestock in the future. Analysis of genetic parameters based on birth weight and litter size in goat to be a basis for selection could be achieved.*
Keywords: *genetic parameters; Birth weight; litter size; crossbreeding; Indonesian goat*

I. Introduction

Goats are small ruminant animals that function as meat and milk-producing (Al-Saef, 2013; Azis, 2012). Goat is livestock biologically productive, easily adaptable to tropical and sub-tropical environments, relatively easy maintenance (Basri, 2019). Indonesia has a very diverse source of genetic goats both imported and local goats with high productivity. One type of goat that has high productivity, has a good body conformation, fast growth, good reproductive properties, and good carcass quality (Basri, 2019; Neri et al., 2018). The crossing of Boer goat with local goats is expected to increase the productivity of local goats. Etawah Peranakan (PE) Goat is an Indonesian goat which is commonly used as meat and milk-producing (Azis, 2012; Harowi, 2016).

The low productivity of PE goats was seen among others in the low birth weight so that the increase in birth weight through selection while increasing birth weight and litter size (Azis et al., 2020; Harowi, 2016; Nurgiartiningsih, 2012). The low productivity of PE goats is also seen in the low number of twin births. Twin births in goats are high heritability traits. Goats with multiple births produce higher parent productivity index values than single births. Twin birth is a beneficial trait because it increases the number of young livestock as replacement stock (Al-Saef, 2013; Radhika et al., 2015).

Improving the quality of the results of the crossing will be achieved by the application of a targeted and continuous breeding program. Evaluation of the genetic potential of males that can be identified from the performance of offspring is one of the most important

programs for achieving optimal genetic quality (Azis, 2018; Mustefa et al., 2019). As time goes by and the rampant application of artificial insemination in goats using Boer males has found a lot of goats crossed by Boer males with local females in the community (Radhika et al., 2015).

Based on the facts in the field, the analysis of Boer and PE males used in the crossing program is very necessary to produce superior crossing results. The genetic potential can be reflected from several production traits, including birth weight and litter size of goats to be used as superior cattle in the future.

II. Research Method

This study uses a survey method by determining the sample utilizing purposive random sampling of primary and secondary data. Primary data were obtained from interviews (deep interviews) with farmers while secondary data were obtained from records during the cultivation of goats at Sumber Sekar Laboratory, Brawijaya University. The recording that is used is the parent recording and the recording of goats from F1 crosses. Records include birth weight, gender, litter size.

Data analysis of birth weight and litter size were analyzed using t-test based on (Steel et al., 1991) formula. Data on the sex ratio of males and females of birth weight and the percentage of birth types in the first to fifth parity analyzed descriptively according to (Noor, 2008) formula.

III. Result and Discussion

3.1 Birth Weight

The average birth weight of goats from Boer and PE goats based on F1 parity as presented in Table 1. Research shows that the average male birth weight is higher than females ($P < 0.05$). The average birth weight results based on parity (1, 2, 4 and 5) showed that female birth weight was higher than male parity ($P < 0.05$). The birth weight of male goats at an average parity is higher than female goats. This is due to the influence of hormones in male individuals on fetal development so that the birth weight of male is higher than that of females. The average birth weight of male goats is higher due to the inheritance of male elders and their parents. The male parent and parent will inherit 50% of genetic traits to their offspring (Yonghong et al., 2001). According to (Azis, 2012; Mustefa et al., 2019), male birth weight is almost always heavier than female goat in the same goat nation with the same birth type. The birth weight is influenced by differences in hormones that affect fetal growth in the mother's womb (Nasich, 2010). Androgen hormones found in the hormonal system of male goat fetus work and produce growth processes in all body tissues (Ahunu et al., 1997; Thepparat et al., 2012). This is different from in the female fetus, that the androgen hormones present in the fetus of the female goat restrict the growth of the pipe bone in the prenatal phase (Mia et al., 2013; Pralomkarn and Tumwasorn, 2011). The hormone estrogen has worked since the fetus was 50 days old in the mother's womb. Pipe bone is a place where muscles are attached. Inhibition of the growth of the pipe bone tissue causes stunted muscle growth causes the birth weight of male goats is higher than female goats.

Parity	Birt Weight		Average
	Male	Female	
Parity 1	3,80±0,45	4,09±0,66	3,91±0,15
Parity 2	3,61±0,79	3,80±0,80	3,71±0,01
Parity 3	4,22±0,71	3,20±0,57	3,71±0,10
Parity 4	3,70±0,76	3,88±0,95	3,79±0,14
Parity 5	4,27±0,25	4,40±1,63	4,33±0,99
Total	**3,92±0,59**	**3,87±0,90**	**3,89±0,29**

Based on the results of the study in Table 1, it shows that the birth weight of individual goats in the second, third and so on parity is higher than the birth weight of the goats in the first parity (P <0.05). That is because the reproductive organs of the female parent in the first parity are not fully developed, whereas, in the second, third and so on parity are more perfect. The more perfect reproductive organs of female goats cause the born goat has a higher birth weight (Neri et al., 2018). The parent reproductive organs experience development with the increasing age of the goat parent (Mia et al., 2013; Neri et al., 2018).

Factors affecting the birth weight of goat children vary and are influenced by several factors such as genetic (Ahunu et al., 1997), feed, sex, litter size and parity (Azis, 2012; Azis et al., 2020). Birth weight is more influenced by longing factors. There are two factors of missed are prenatal and postnatal (Pan et al., 2015). The birth weight depression is caused by the maternal effect during prenatal care. The factors that give and maintain the growth of the fetus in the uterus can affect the birth weight of a young goat (Supakorn and Pralomkarn, 2009; Thepparat et al., 2012). In addition, the number of fetuses contained by the mother greatly affects pregnancy. If the number of fetuses is small, the development of the fetus in the uterus will take a long time so the pregnancy will also belong and the weight of the goat body will be greater. Therefore, each parent parity has a different effect on the amount of birth weight of goat crossbred (Nasich, 2010; Nurgiartiningsih, 2012).

The birth weight of female goats in the first parity is different from the second and fourth parity (P> 0.05). This is caused by the second and fourth births are all twins. Goats born in twins and females have lower birth weights than single goats. The twin births resulted in lower birth weight of goats than single births. Fetuses that are in a twin state experience competition in obtaining nutritional intake while in the mother's womb (Al-Saef, 2013; Azis, 2012). Another factor influencing the birth weight of goats is the quality and quantity of feed given to goats during pregnancy (Hassen et al., 2012). The average birth weight is influenced by the breed of the goat in question, sex, type of birth, the age of parent, and foodstuff. Parents who are fed poor quality will give birth with low birth weight (Elieser et al., 2012).

3.2 Sex Ratio of F1

The results of research on the percentage of F1 sex resulting from the crossing of Boer and PE goats will be presented in Table 2. The sex ratio of female goats is on average higher than females, namely 45.73% and 54.27% (Table 2). The sex ratio of males is higher than females only in the third parity of 64.29% and 35.71%. The sex ratio is influenced by genetic factors from the parent. Parents born of elders who produce more female offspring will give birth to F1 generations with a higher number of female goats, and vice versa (Mia et al., 2013; Syakur and Azis, 2020). This result can also be explained through the sex determination approach based on the ratio of XX and XY chromosomes. In artificial insemination marriage, the chance of the X chromosome joining of a female individual and the X chromosome of a male individual is greater than the chance of the X chromosome

joining of a female individual with the Y chromosome of a male individual (Iquebal et al., 2013; Noor, 2008). Feed factor is given to the mother during pregnancy also affects the sex of the child born. According to (Noor, 2008; Nurgiartiningsih, 2012), feed conditions with certain anion and cation ratios affect the sex of the fetus to be born.

Tabel 2. Sex ratio F1 of Boer and PE goat crosses

Parity	Sex Ratio (%)	
	Male	**Female**
Paritas 1	31,25	68,75
Paritas 2	57,14	42,86
Paritas 3	64,29	35,71
Paritas 4	38,46	61,54
Paritas 5	37,50	62,50
Average	**45,73**	**54,27**

3.3 Litter Size

The average number of litter sizes for goats based on F1 births is presented in Table 3. The average litter size for single goats, twins, and triplets is 25%, 50%, and 25%, respectively. The results of this study indicate that litter size with twins is more dominant than the number of single births and triplets. The results generally indicate that the litter size of the mother goat gave birth to twins both twins and triplets by 80%. Profiling in goats is influenced by the nation and genetics, in addition, proliferation is also influenced by the age of the parent when giving birth (Pralomkarn and Tumwasorn, 2011). The number of childbirth plays an important role in determining the rate of population increase because a high litter size will affect the increase in population (Thepparat et al., 2012).

Table 3. Types of single births, twins, and triplets resulting from crossing

Parents	Type of Parity (%)		
	Single	**Twins**	**Triplets**
Group 1	12,5	50	37,5
Group 2		50	50
Group 3		50	50
Group 4	42,9	57,1	
Group 5	37,5	62,5	

Nested parity and parity in males can have a very significant effect on litter size ($P<0.01$). In addition, the litter size compared between each parity and each parity nested in the male showed very significant differences ($P <0.01$). The mean litter size of good-born goats was found in parity 1, 2, and 4 (Table 4). According to (Nurgiartiningsih, 2012), since the first birth, the number of children tends to increase and peak at the third and fourth births, then it is stable until the seventh birth and then decreases. This can be caused by a parent ovulating more ovum than when he was a virgin. The rate of ovulation will continue to increase until the seventh parity, but in general, the sows are rejected at the fifth and sixth parity. This is because the reproductive power begins to decline to produce a low pregnancy rate. The more mature the parent, the more the weight of his life is followed by the matured

function of the reproductive organs, thereby increasing the capacity of the uterus and allowing maximum fetal development (Radhika et al., 2015; Yonghong et al., 2001).

Table 4. Litter size of goats Crossing the first to the fifth parity

Parity	**Litter Size ekor**
Parity 1	$1,71 \pm 0,22^{a}$
Parity 2	$1,86 \pm 0,07^{b}$
Parity 3	$1,71 \pm 0,15$
Parity 4	$2,14 \pm 0,11^{c}$
Parity 5	$1,14 \pm 0,56$
Average	**1,71 ± 0,22**

The highest litter size is shown in parity 4 and parity 2 which is 2.14 ± 0.11 and 1.86 ± 0.07 tail. This result was higher than parity 1, which was 1.71 ± 0.22 (P <0.05). Factors affecting litter size are age, nationality and genetic herd. The age of the parent is one of the factors that affect the litter size because it is related to the readiness of the female reproductive organs (Harowi, 2016). Female cattle that are mated at a young age produce many single children because their reproductive organs are not yet mature enough. This is different from the results of this study as shown in Table 3, although the proportion is very small at 25%..

The t-test results showed that the liter size between the two nations was significantly different (P <0.05). This is thought to be due to the reproductive ability of the parent goat, especially a good male. This result is better than peanut goats with an average litter size of 1.57 and PE goats 1.51 - 1.57. Litter size is the effect of the results of the fertility of the parent with the male as well as the management control system that is carried out both during marriage and during maintenance. Litter size will be influenced by the age of the parent, breed, and parity (Ahunu et al., 1997; Elieser et al., 2012). The litter size will increase with age, but parity does not have a different effect on litter size in the same age. In addition, litter size is determined by three factors: the number of eggs produced during estrus and ovulation, fertilization, the state of the mother during pregnancy, and embryonic death (Pan et al., 2015; Pralomkarn and Tumwasorn, 2011). These three factors are influenced by the age of the parent, bodyweight of the parent, male goat, ambient temperature, and genetic parent. The twin births are traits that are influenced by genetic factors so that the parents pass on to their offspring (Nurgiartiningsih, 2012; Radhika et al., 2015).

IV. Conclusion

The results of crossing Boer and PE goats have a high productivity and proliferation rate. mean birth weight parity of male goat parity was higher than female goat (P <0.05). The average yield at parity 1, 2, 4 and 5 female goat birth weight was higher than male parity (P <0.05). The sex ratio of female goats was on average higher than male (45.73% and 54.27%). The average of litter size of mothers who gave a birth single, twin and triplet was 25%, 50% and 25%, The results generally indicate that the litter size of the parent goat gave birth to twins both twins and triplets were 80%. The highest litter size was at parity 4 and parity 2 (2.14 ± 0.11 and 1.86 ± 0.07 tail). This result was higher than parity 1 (P <0.05). The crossing

of Boer and PE goats at parity 4 has a high prolific rate. Goats with a fourth parity that are born with twin birth types and high birth weight can potentially have good genetic and can be used as stock prospective livestock. Analysis of genetic parameters in terms of birth weight and litter size in F1 goats to be done as a basis for selection so that genetic progress could be achieved.

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