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Estimation of Repeatability and Heritability of the Weaning Weight and Adult Weight for Friesian Holstein Dairy Cattle in BBPTU-HPT Baturraden, Purwokerto

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Abstract**—** *The purpose of this study was to estimate the value of genetic parameters consisting of the repeatability values of weaning weight and adult weight, as well as the heritability of weaning weight and adult weight. The research material was the recording data of weaning weight and adult weight of 100 cows. This research method was a historical survey method of performance data and production data. The variables observed in this study were weaning weight and adult weight. The data was analyzed by using variance method, namely correlation in class to calculate the value of repeatability with the number of measurements more than two measurements of per individual and half brother correlation to calculate the value of heritability with the number of children of each male that was not the same. From the result of the study, it can be concluded that the value of weaning weight repeatability and the adult weight of Holstein Friesian (FH) dairy cattle in BBPTU-HPT Baturraden was high at 0.54 ± 0.05 and 0.58 ± 0.05. The heritability of weaning weight and adult weight was also high, 0.59 ± 0.38 and 0.60 ± 0.39. Repeatability and heritability values were equally high, so both can be used as considerations in decision making for selection*.

Keywords**—** *Wean weight, adult weight, repeatability and heritability*.

I. INTRODUCTION

Dairy cattle is one of the livestock commodities that has an important role in efforts to fulfill national milk needs. Every year the demand for milk is increasing along with the increasing population and increasing public awareness of the importance of healthy living. The availability of milk as one of the foodstuffs has become a special concern. In addition to fulfilling increased milk needs, milk production for dairy cattle is also one of the factors that have the economic value from a dairy farming business.

Improving maintenance management and improving genetic quality is a way of increasing national milk production. So far, the marriage program of domestic FH cattle is still directed to the outbreeding marriage system so that the FH dairy cattle can maintain its purity so that it is expected to express high milk production performance from generation to generation [1]. As the development of science and technology in the field of animal husbandry, breeding now has an important function and role in efforts to improve the genetic quality of livestock because it can improve the genetic potential of livestock for the better. The criteria used in determining livestock as prospective seedlings is the production of milk produced at least 5000 liters per lactation, and for national cattle of Indonesia is used a national standard of milk production of around 3200 kg per lactation. The result of Anggraeni's research stated that genetic improvement of domestic FH cattle needs to be done through the selection to get seed dairy cattle with excellence like milk production based on the conditions of cultivation in people's farms and under the stress of Indonesia's tropical climate [2].

The selection of a female dairy cattle or selection is very important because in the end the selection gives permanent results and accumulates. In selection, livestock can only be selected based on assumptions, which animals are considered good and which animals are considered bad. Whether or not a selection is very dependent on accuracy in making estimates. Accuracy in a selection depends on the method or method of estimating genetic quality. The selection process is carried out to achieve the ultimate goal of genetic advancement of livestock and is based on the reason to maintain the number of livestock, mated with superior males to obtain superior female children and can be used as a substitute parent and will get a male child who will be used as a pacemaker in the program artificial insemination. Selection is done to find out that female dairy cattle have high production capability and can inherit these traits to their offspring.

The genetic superiority of milk production can be evaluated through a selection process based on genetic parameters. Genetic parameters can be estimated from certain values, thus a quantity that describes the genetic condition of an observed characteristic. The magnitude of these genetic parameters can be measured and predicted. Genetic parameters are needed for selection and are expected to provide improved genetic quality for livestock. The parameters used in this study are repeatability and heritability of both livestock performance; weaning weights and adult weights.

II. MATERIALS AND METHODS

A. Research Materials

The research material used in this study was a record in the form of weaning weight records and 100 adult weights.

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B. Research Methods

The method used in this study is a historical survey method of performance data and production data.

C. Research Variable

The variables observed were weaning weight and adult weight that had been corrected to bodyweight 120 days for weaning weight and body weight 365 days for adult weight.

D. Data Analysis

The data was analyzed by using variance method, namely correlation intra class to calculate the value of repeatability with the number of measurements more than two measurements of per individual and paternal halfsib correlation to calculate the value of heritability with the number of children of each male that was not the same.

III. Result and Discussion

A. Wean Weight of Holstein Friesian (FH) Dairy Cattle

Dairy cattle calves found in BBPTU-HPT Baturraden weaned at the age of 4 months. Furthermore, the calf was maintained in a separate environment with its mother and given good feed based on calf needs so that it can achieve good weight gain. In BBPTU-HPT of Baturraden, calves from the age of 3 months have been given concentrate feed. Calves which were 3 - 3.5 months old were given 0.25 kg/day concentrated feed and 12.5 kg/day grass. Calves which were 3.5 - 4 months old are fed 0.5 kg/day and grass 15 kg/day. Calves that were 4 - 5 months old were fed with 2 kg/day concentrate and grass 20 kg/day. Calves which were 5 - 6 months old were fed 2.5 kg/hr concentrate and grass 25-30 kg/day. The provision of drinking water for calves was carried out in adlibitum, i.e. water was given in unlimited quantities and was always available for calves. The size of the calf weights at this location, ranging from 150 - 165 kg with a weaning age of 4 months (uniform to 120 days). Bodyweight every month was ± 10 kg/head. This further supports the results of a study conducted by [3] which stated that within 6-7 months weaning calves grow into heifers with a bodyweight of 220 kg. Therefore, from the age of 3 months to 10 months calf must get a good and sufficient amount of feed so that it can reach body weight between 620 - 700 g/h.

B. Adult Weight of Holstein Friesian (FH) Dairy Cattle

The adult weight analyzed in this study was the weight of cattle at 12 months of age. In the study location, 10-year-old heifer would be kept in a special cage in which the cattle were prepared for mating and pregnant. Adult weight was a continuation of weaning weights. Livestock with high weaning weights was expected to have high adult weights too. It was known that animal body weight can affect the amount of milk production. According to [4], the ideal body weight of adult female FH cattle is 682 kg.

Growth of heifers can influence the length of the shortage of the first lust Slow-growing heifers would experience the first lust delayed and be likely to experience pregnant difficulties. Low-growth cattle would produce lower milk in the first lactation compared to domestic cattle with rapid growth conditions. Dairy cattle in this location were maintained as nursery destinations. Adult weight of cattle is 12 months - 275 kg. The weight of livestock at this location was comparable to the results of research conducted by [5] on the growth curve of dairy cattle and stated that inflection farms reached 7.5 months of age with a bodyweight of 145.45 kg, while for businesses the nursery was reached at 9.3 months with a bodyweight of 214.70 kg. The inflection point was an important point when cattle reach puberty. Some specific events can be found at the inflection point, including the maximum speed of growth, the lowest occurrence of puberty and mortality. Therefore, cattle body weight aged 12 months can reach ± 260 kg and then livestock can be prepared for mating and pregnant.

C. Repeatability of Weaning Weight and Adult Weight of Holstein Friesian (FH) Dairy Cattle

Repeatability (r) or repetition number is defined as a phenotypic correlation between present performance and future performance in an individual [6]. In this study, the number of measurements of more than two measurements for per individual then the results of the calculation of variance analysis as interclass correlation showed that the size of the overall correlation between all possible pairs. Variable component values between individual cattle (σ_w^2) for weaning weights were obtained at 30.38 and the various components of measurement in individual cattle for weaning weights were 25.11, then the results of the estimation of weaning repeatability values were 0.54 ± 0.05. Whereas the component values of different individuals (σ_w^2) for adult weights were 13950.17 and the components of various measurements in individual cattle for adult weights were 9752.63, then the result of estimation of repeatability values for adult weights were 0.58 ± 0.05. The two results of calculating the value of repeatability are based on the statement of [6] that the concept of repetition rates, the range of environments is distinguished between a permanent environment (σ_w^2) and a variety of temporary environments. Repetition numbers were part of a variety of phenotypes caused by differences between permanent individuals. Therefore, repeatability included genetic influences plus permanent environmental influences.

In this study, permanent influential environmental influences were cattle and feed given during the mother's care when pregnant until delivery. This is based on the opinion of [7] the effect of the mother on her child begins when conception is born, until the age of weaning. In this case, of course, the influence of the parent as an environmental factor, would only be decisive in the phenotype and not at all in the genotype. In other words reproduction, ease of giving birth, and milk production were important components for determining the parent. Therefore, the selection of a good parent in this study was very necessary, because it would affect the genetic quality improvement in the farm.

The standard error obtained in the weaning repeatability calculation was 0.055, while the standard error in the calculation of adult weight repeatability was 0.052. This value

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measures the extent to which sample averages can be trusted as estimators of population averages. The results of the standard error calculation were smaller than the value of repeatability, so the value of repeatability of weaning weights and adult weights of the results of the research can be used as a guideline for consideration of decision making in the selection program. According to [7], the greater the value of repeatability is close to 1.0 because the diversity of these traits is controlled by the genetic factors of these animals and the variety of permanent environments. In this study the value of weaning repeatability and adult weight included was high so it can be seen that the diversity of these properties was influenced by animal genetic factors and also a variety of permanent environments. This was based on the criteria for the value of repeatability described by [8], i.e. repeatability was classified as low if the value was <0.2, medium if the value ranges from 0.2 - 0.4, and high if the value was> 0.4. High repeatability values indicated that the ability of livestock to repeat the nature of production in the next period would also be high and vice versa.

D. Heritability of Weaning Weight and Adult Weight of Holstein Friesian (FH) Dairy Cattle

The estimation of heritability values of weaning weight and adult weight of Holstein Friesian (FH) dairy cattle in this study used the paternal half-sib correlation method with the same number of children each male. This method was chosen based on the opinion of [9] which stated that the method of estimating the value of heritability can be done by using an analysis of family relationships based on the similarity of traits between different offspring. The results of the calculation of the heritability of weaning weights were obtained at 0.59 ± 0.38 and the adult heritability weight values were 0.60 ± 0.39. The heritability values of these two performances were high. According to [10], the heritability value categorized as moderate to high can provide clues that the selection will be more effective and efficient in improving genetic quality improvement compared to the selection carried out at low heritability values. The high value of weaning heritability and adult weight of cattle in this study was due to the large genetic influence that dominated the phenotypic variety which in this case was thought to originate from its parents, namely as superior livestock. Besides, management systems that were intensive in maintenance also influence the amount of heritability produced.

Weaning weight heritability and adult weights can be used as guidelines for the consideration of decision making in selection efforts. This was because the heritability values of the two performances were categorized as high, according to the opinion of [11] which stated that the higher the heritability value of a selected character, the higher the increase in the properties obtained after selection. Therefore, the proper breeding program used in genetic improvement of dairy cattle was by selection so that it would produce genetic progress after selection. This was based on the opinion of [6] which stated that heritability is one of the most important concepts in livestock breeding and can be used as a consideration in evaluating livestock, selection methods, and marriage systems and can be used to predict genetic progress due to selection in improving a trait.

IV. CONCLUSION

Based on the results of the study, it can be concluded that the repeatability value of weaning weight and the adult weight of FH dairy cattle in Baturraden BBPTU-HPT was high, which was 0.54 ± 0.05 and 0.58 ± 0.05. Likewise, the high heritability of weaning weights and adult weights were classified as 0.59 ± 0.38 and 0.60 ± 0.39. Both of these values were high so that both repeatability values and wean weight heritability values and adult weights can be used as guidelines for the consideration of decision making in selection efforts.

V. SUGGESTION

Ripitability and heritability in this study can be used as a basis for consideration in selection efforts to produce genetically good livestock for the next generation.

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