Weaning rate, birth weight, and weaning weight of Jawarandu and Boer crossbreed goat from naturally serviced and artificially inseminated does

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Abstract. Two types of mating had been practiced in the crossbreed of Jawarandu does and Boer buck that produced Boerja goat, the natural service and artificial insemination. This study aimed to compare the weaning rate, birth weight, and weaning weight of offspring from both mating methods and analyze the different birth and weaning weights on different sex and birth type. A total of 271 kids were born from naturally serviced (NS) and artificially inseminated (AI) does (221 and 50, respectively). All kids were managed in the same condition. The number of kids died pre-weaning, birth weight, and weaning weight were recorded and analyzed. The result showed that the weaning rate of AI kids was significantly higher than NS kids. The birth and weaning weights of kids from both groups were not significantly different. Male and single kids had heavier birth and weaning weights than female and twin kids. Overall, the survival rate of AI kids until weaning is better than NS kids. The birth and weaning weight in NS and AI are not different but male and single kids are heavier than female and twin kids in both groups.

1. Introduction
Boerja goat is a crossbreed between Jawarandu does and Boer buck that is widely found in Indonesia [1]. Jawarandu is an Indonesian local goat with a good adaptability to the tropical climate and good reproductive performance. This breed is a crossbreed between Kacang goat and Peranakan Ettawa (PE) with [2]. In order to improve its genetic quality as meat-purpose goat, it has been crossbreed with Boer buck that has an excellent growth rate [1,3].

In the goat crossbreed program, natural service (NS) and artificial insemination (AI) are practiced [4–6]. AI has been used in goat production for several purposes, including genetic improvement, breeding programs, conserving the native breed, and introducing a new breed [7]. In addition, it is also practiced to increase the efficiency compared to the natural meeting that needs bucks to conceive some does physically. However, the AI also have negativity in the term of cost and also special skills that can only be practiced by the trained personnel [5,8]. The high cost of AI is especially due to the low result of a successful pregnancy. In Jawarandu and Boer crossbreeds, the AI has been reported to have only 21% of pregnancy while the NS can be as high as 73.07% even though both methods showed similar litter size and twinning rate [4].

A successful crossbreed can be evaluated through the offspring’s productivity. It can be seen from several indicators, including weaning rate, birth weight, and weaning weight which showed the potency of goat growth [1]. Increasing productivity has been reported in the crossbreed of Jawarandu and Boer...
that produced Boerja [9,10]. The crossbreed of Jawarandu does and Boer buck has resulted in a better heterocyst in its F1 [3] and F3 [10]. However, there is no report of the productivity of Boerja kids from different mating methods. Factors affecting the goat’s body weight are divided to two groups, the genetic and non-genetic parameters [11]. The genetic parameter is related to the doe and buck traits passed down to the kids, while non-genetic parameters includes sex, birth type, and litter size [11–13]. This study aims to analyze the weaning rate, birth weight, and weaning weight of Boerja kids from NS and AI kids. In addition, we also analyze the non-genetic parameter for birth and weaning weight that consist of sex and birth type.

2. Materials and method

2.1. Materials
The study was conducted using kids recording data from CV. Kambing Burja, Malang, Jawa Timur. The total of Jawarandu does that had parturition after NS or AI was 198 that comprises 161 for NS and 37 for AI with fresh semen collected from Boer buck in the farm. The NS does were NS in pen with total kids born from these does was 271 kids, 221 from NS does and 50 from AI does. In NS group, there was 121 female and 110 male, while in AI group, the female kid was 26 and the male kid was 26. From the NS does, there was 101 single kid and 120 twin kids, while in the AI group the single kid was born 24 individuals and twin 26 individuals. All of the kids were managed under the same condition.

2.2. Method
The method used in this study was by comparing the weaning rate, birth weight, and weaning rate recorded data of the kids from NS and AI does. The weaning rate is the percentage of kids survived until weaning. All the kids were weighed after parturition and on the weaning day, at 70 days of age. Both weighing processes were recorded, and the result was then divided by the population at the time for the average result. Male, female, single, and twin kids’ data were collected, and all of the results were analyzed by t-test at $\alpha = 0.05$.

3. Results
The result, as presented in Table 1, showed that the weaning rate of NS was 84.2% which is lower than AI kids (96%). In the NS group, the weaning rate in the single-born kids was 88.23% which was higher than the weaning rate of twin kids with 80.67%. On the contrary, the weaning rate of twin kids in the AI groups was slightly higher than the single kid, 96.15% vs. 95.83%, respectively. Lehloenya et al. [14] reported that single kids are stronger than kids from multiple births, which often lead to a lower weaning rate in the twin groups showed in the NS group. The kid loss is related to physiological starvation [15], so that the multiple birth and high population may lead to high competition and lower nutrition intake, which cause weakness and eventually death. Meanwhile, in the AI group, the similar weaning rate of single and twin kids was possibly related to the total population that only 50 individuals compare to 221 in the NS group.

The result of birth and weaning weight measurement between NS and AI groups do not present any differences. The average birth and weaning weight were $2.30 \pm 0.34$ kg and $12.09 \pm 2.99$ kg for the NS group, and $2.19 \pm 0.35$ kg and $12.04 \pm 3.11$ for the AI group was $2.19 \pm 0.35$ kg, respectively. This result showed a different trend than another study in Alpine goat, where the NS kids were heavier than kids from AI group [15]. The birth weight reportedly had a negative correlation with litter size [16,17]. However, based on the previous report in a similar study site, the litter size of both methods did not have any differences ($1.37 \pm 0.50$ for NS and $1.35 \pm 0.56$ for AI) [4]. This may explain the similar result of birth and weaning weight.

The comparisons of female, male, single, and twin birth weight between NS and AI methods are not significantly different. Similarly, in the weaning weight, most of the comparisons of the parameters showed no differences. In addition, most of the results of birth and weaning weight comparisons between female and male kids within the NS and AI group do not show any significant difference except for
weaning weight in NS (11.76 ± 4.65 kg vs. 12.43 ± 5.68, respectively) (Table 2). However, the general trend showed that males have a heavier weight. This result is similar to other studies in Angora goats [12], in Ettawa goats [13], and in Burja goat, where the males are heavier [1]. Sex is one of the most prominent factors in the non-genetic parameter affecting the body weight [11,13]. Heavier males are suggested due to the differences in physiological and hormonal activity [13].

Table 1. Comparison of weaning rate, birth weight, and weaning weight of Burja goat from naturally serviced and artificially inseminated does

|                     | NS               | AI               |
|---------------------|------------------|------------------|
| Weaning rate (%)    | 84.2 ± 0.34      | 96 ± 0.35        |
| Weaning rate single kid (%) | 88.23 ± 0.34 a   | 95.83 ± 0.35 b   |
| Weaning rate twin kid (%) | 80.67 ± 0.34 a   | 96.15 ± 0.34 b   |
| Birth weight (kg)   | 2.30 ± 0.34 a    | 2.21 ± 0.35 a    |
| Weaning weight (kg) | 12.09 ± 2.99 a   | 12.04 ± 3.11 a   |
| Female birth weight (kg) | 2.29 ± 0.33 a    | 2.21 ± 0.32 a    |
| Male birth weight (kg) | 2.30 ± 0.35 a    | 2.21 ± 0.35 a    |
| Female weaning weight (kg) | 11.76 ± 4.65 a   | 11.94 ± 4.08 a   |
| Male weaning weight (kg) | 12.43 ± 5.68 a   | 12.15 ± 3.44 a   |
| Single birth weight (kg) | 2.41 ± 0.35 a    | 2.25 ± 0.38 a    |
| Twin birth weight (kg) | 2.20 ± 0.31 a    | 2.17 ± 0.33 a    |
| Single weaning weight (kg) | 15.04 ± 0.35 a   | 14.06 ± 2.26 a   |
| Twin weaning weight (kg) | 10.57 ± 2.26 a   | 10.02 ± 2.23 a   |

*Different letter in the same column shows significant difference (p < 0.05)

Table 2. Comparison of birth and weaning weight of female and male Boerja kids from naturally serviced and artificially inseminated does

|                     | Female          | Male            |
|---------------------|-----------------|-----------------|
| NS                  |                 |                 |
| Birth weight (kg)   | 2.29 ± 0.33 a   | 2.30 ± 0.35 a   |
| Weaning weight (kg) | 11.76 ± 4.65 a  | 12.43 ± 5.68 b  |
| AI                  |                 |                 |
| Birth weight (kg)   | 2.21 ± 0.32 a   | 2.21 ± 0.35 a   |
| Weaning weight (kg) | 11.94 ± 4.08 a  | 12.15 ± 3.44 a  |

*Different letter in the same column shows significant difference (p < 0.05)

The comparison between single and twin kids’ birth and weaning weight showed a significant difference, except for the birth weight of AI kids (Table 3). The single kids’ weights were heavier than the twin kids. This is in accordance with other studies in Alpine [15], Angora [12], and Ettawah goat [13]. It is suggested due to the nutrition intake in twin kids which is tend to be lower than in single kids [13]. The physiological starvation in the uterus and also from lower milk consumption in the weaning period is suggested to cause a lower growth rate in the weaning period [12]. It is highly suggested that the management system of twin kids should be more intensified than a single kid.

Table 3. Comparison of birth and weaning weight of single and twin kids from naturally serviced and artificially inseminated Jawarandu does

|                     | Single          | Twin            |
|---------------------|-----------------|-----------------|
| NS                  |                 |                 |
| Birth weight (kg)   | 2.41 ± 0.35 a   | 2.20 ± 0.31 b   |
| Weaning weight (kg) | 15.04 ± 0.35 a  | 10.57 ± 2.26 b  |
| AI                  |                 |                 |
| Birth weight (kg)   | 2.25 ± 0.38 a   | 2.17 ± 0.33 a   |
| Weaning weight (kg) | 14.24 ± 2.26 a  | 10.02 ± 2.23 b  |

*Different letter in the same column shows significant difference (p < 0.05)

4. Conclusion
This study shows that the survival of kids from AI does was higher than the NS. Mating procedures, the NS and AI, were not affecting the birth and weaning weight of Burja goat. The differences were found in between sex and birth type in which male and single kids are heavier than female and twin kids.
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