Reproductive performance comparison between natural and artificial service in Jawarandu goat

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Abstract. This study was aimed to compare reproductive performance of Jawarandu goat serviced naturally and artificially. In total 433 Jawarandu does were randomly allocated into two groups namely Natural Mating (NM; n=233) and Artificial Insemination (AI; n=200). In this study, reproductive performance was measured in percentage of pregnancy, litter size, and kid born single, twin and triplet. Between groups, data were compared using t-test at α = 5%. NM group was performed in mating pen, and per Boer buck was colonized with 20-25 does for 45 days, followed with pregnancy check using ultrasonography at day 45 post insemination. In AI group, oestrous signs were observed in morning and evening, while insemination was done maximum 12 hours after sign of oestrous. The percentage of pregnancy in NM was higher (p<0.05) compared to AI (73.39 vs 21.00%), litter size (1.37±0.49 vs 1.35±0.56; p>0.05). Similarly, in percentage of kid born single, twin and triplet, no differences were found in both groups (63.35 vs 64.86; 36.02 vs 35.14; and 0.62 vs 0%; respectively). All in all, natural service gives better reproductive performance compared to the artificial one. Its suggested due to factors related to the ability to determine the right time for service.

1. Introduction
Goat’s crossbreeding is a common practice in Indonesia as an effort to increase the genetic quality of local breed. One of the practices is crossbreeding between local breed called Jawarandu with imported breed, Boer goat, producing Boerja goat [1,2]. Jawarandu goat is a meat-purposed goat, the crossbreed between Ettawah and Kacang goat with phenotypically similar to Kacang [3]. Jawarandu has good reproductive performance and are well adapted in Indonesia. Meanwhile, Boer goat is originally from South Africa with excel growth and prolific. Boer buck can grow up to 135 kg while the doe until 100 kg with average daily gain up to 0.18 kg/day [4]. Based on these characteristics, Jawarandu doe and Boer buck was chosen in the crossbreeding program to improve the local goat productivity.

Successful goat crossbreeding is related to reproductive performance of the breeds. Reproductive performance can be assessed through several parameters, such as pregnancy rate, kidding rate, twinning rate, litter size, birth weight, weaned weight, and pre-weaned mortality [5–7]. Those parameters are important as it is related to production cost and benefit for farmers, including in crossbreeding of Jawarandu and Boer goat.

In the crossbreeding between Jawarandu and Boer, two methods of services have been used: natural service (NS) and artificial insemination (AI). Both methods have different pros and cons. In NS, the procedure required at least one buck to serve many does. The process is not efficient as a buck has limited ability to serve does in a day. Meanwhile, in AI, one buck can serve dozens of does through
frozen semen production. Moreover, AI has positive effect in genetic quality improvement, spreading the genetic materials, and preservation of threatened breed [8]. However, AI has increased the production cost and have to be performed by expert inseminator with good observation of oestrous sign to determine the timing. Both procedures should be evaluated to determine the best method in Jawarandu and Boer crossbreeding. This study aimed to compare the reproductive performance between NM and AI in Jawarandu doe in the crossbreeding practice with Boer buck.

2. Methods
In total, 434 Jawarandu does and 18 Boer bucks were used in this study. The does were provided by local market while the bucks were imported from Australia. The does were divided into two groups: NM groups (234 does) and AI groups (200 does) and placed in colonized pen with 20-25 individuals in each pen. In NM groups, a buck was introduced to a pen for 45 days. Meanwhile, in AI group, the oestrous signs of each individuals was observed every morning and evening time, then the insemination was performed 12 hours after the sign was observed. Boer semen was deposited using speculum at the end of cervix. After 45 days, all of the does were checked using USG (Draminski) to determine pregnancy. All of the procedures were performed in CV. Kambing Burja, Malang, Jawa Timur.

The reproductive parameters observed in this study were: pregnancy rate, litter size (LS), and the type of kid born namely single kidding, twinning rate, and triplet rate. Pregnancy rate was determined as the percentage of pregnant does. Litter size was calculated by comparing the number of number of does that gave birth. The single, twinning, and triplet rate calculate by comparing the number of does that gave birth to single, twin and triplet with total number of does. Those parameters of NM and AI were analyzed by t-test at $\alpha = 0.05$.

3. Results and discussion
The parameters of reproductive performance in NM and AI method presented in Table 1. The results show that NM and AI have significant difference in pregnancy rate but shows no differences in litter size and single, twinning, and triplet rate. The higher percentage of pregnancy rate in NM in accordance with previous studies in goat NM and AI comparison [5, 6]. The AI pregnancy rate in this study is lower than pregnancy rate of goat AI in Indonesia’s local breed which ranging from 30–47% [9]. Lower pregnancy rate in AI related to some factors, including AI timing and application of AI technique by the inseminator [10]. Timing in AI should be approximately 12–18 hours after estrous sign observed or 5–10 hours before ovulation to produce success insemination [6].

| Parameter        | Natural mating | Artificial insemination |
|------------------|----------------|------------------------|
| Pregnancy rate (%) | 73.07<sup>a</sup> | 21<sup>b</sup>        |
| Litter size      | 1.37 ± 0.50<sup>a</sup> | 1.35 ±0.56<sup>a</sup> |
| Single kidding (%) | 63.35<sup>a</sup> | 64.86<sup>a</sup> |
| Twinning rate (%)  | 36.02<sup>a</sup> | 33.14<sup>a</sup> |
| Triplet rate (%)  | 0.62<sup>a</sup> | 0<sup>a</sup> |

<sup>a</sup>Different letter in same column shows significant difference (p<0.05)

The sperm have to capacitate in the cervix and uterus 5–6 hours prior to fertilization [11]. Late or earlier insemination will reduce the success fertilization. Therefore, the observation of estrous sign should be done carefully and precisely by the expert. Another method to make sure the precise timing in AI is using estrous synchronization with hormones PGF2α [9, 12]. However, in this study, AI timing determined by eye observation in the morning and afternoon so that the onset of estrous could be missed. There is a possibility of miss observation and timing on AI application which caused low success rate. Another factor related to success rate in AI is the application of AI technique. Semen deposition in deeper cervical region have better result in producing pregnancy [13]. However, the anatomy of cervical ostium that surrounded by wrinkled fibrous tissue, especially under oestrogen control during estrous,
make it difficult to penetrate into deeper cervix [13]. That condition was found during the insemination in this study which result in low pregnancy rate.

Litter size, single, twinning, and triplet rate of NM and AI show no difference (p>0.05). Litter size and number of kids born are related to genetic, nutrition, parity, and age [14]. The similar result in those parameters showed that there is similar variation in genetic, nutrition, body size, parity and age of doe used in both methods. However, litter size in this study is lower than previous study in Jawarandu and Boer crossbreed using NM (1.74–1.82) [15, 16]. In addition, LS in this study was categorized lower than PE crossbreed with Boer using NM and AI (1.62 – 1.8 NM and 1.79 in AI) but relatively higher compared to Saanen goat (1.29 ± 0.47) [7, 17, 18]. Twinning and triplet rate in both mating methods also showed lower rate for Jawarandu goat (73.81%) or in PE cross Boer (twinning rate 47%, triplet 3.2%) [19]. One of factors related to LS is body condition in which bigger doe relatively have capability to produce more kids than small one [14, 20]. It indicates that does in this study may have small body size that can be caused by lack of nutrition intake. In addition, low twinning and triplet rate also related to nutrition intake especially near the estrus onset. Low nutrition intake will reduce the possibility of multiple ovulation in doe [14]. Therefore, it indicated that there might be low nutrition intake during onset estrus. Another plausible explanation might relate to the age and parity number of does. Doe produces more kids following the number of parity up to parity 6 started from age 2-6 [18]. However, the parity and age data of does in this study were not available so that there was a possibility of high variation in age and parity. Those variation could have impact to the number of kids produced by the does. Hence, the result of both methods showed that AI does not provide better result than NM.

4. Conclusion
In conclusion, NM showed better reproductive performance compared to AI for Jawarandu goat. Thus, the application of NM is suggested to be used in commercial breeding program.

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