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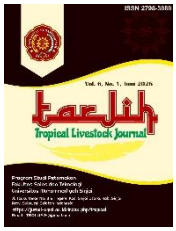

Morphometric Performance of Yearling Dorper × Local Sheep Crossbred Females Under Smallholder Farming Systems in Indonesia

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ABSTRACT

Morphometric measurements of crossbred sheep at one year of age play a crucial role in animal husbandry, particularly in evaluating performance, genetic selection, and enhancing livestock quality. Yearling age is a phase of active growth in sheep. This study aimed to describe the morphometric characteristics of yearling female crossbred sheep, a product of crossing Dorper rams with Thin-Tailed (DET) ewes. The research was conducted at Mitrarama88 Farm in Pandesari Village, Pujon Sub-district, Malang Regency. A total of 42 yearling crossbred female sheep were included in this study, selected through purposive sampling based on animal availability, confirmed health status, and reliable age identification. Animals were maintained under a smallholder management system and fed a combination of field grass and concentrate. The data obtained were analyzed using descriptive statistics, including mean, standard deviation, and coefficient of variation. The results showed that the mean ± standard deviation of body weight, body length, body height, chest girth, hip width, head length, and head width of the yearling crossbred female sheep were 28.89±4.10 kg, 60.67±5.37 cm, 53.93±4.87 cm, 69.34±5.94 cm, 17.82±3.17 cm, 14.70±1.44 cm, and 14.22±1.88 cm, respectively. The observed morphometric improvements are likely attributable to heterosis effects, although parental performance data were not available for direct comparison. These findings suggest that Dorper × DET crossbreeding programs hold significant potential for improving the growth performance of local sheep breeds and could serve as a foundation for more targeted genetic improvement programs.

INTRODUCTION

Several local sheep breeds with specific characteristics have been identified in Indonesia. These breeds have evolved through natural selection and have adapted well to local environmental conditions distinct from those inhabited by exotic breeds introduced during the colonial era. However, the productive performance of local breeds is

generally lower than that of exotic breeds, particularly in growth rate, body conformation, and carcass yield. This condition represents a major challenge for sheep production systems in Indonesia, particularly in efforts to improve meat productivity while maintaining adaptability to tropical environments. Therefore, crossbreeding between local and exotic breeds has emerged as a strategic alternative to enhance productivity while maintaining environmental resilience.

The Dorper sheep, developed from a cross between Dorset Horn and Blackhead Persian (Pogodaev *et al*., 2023), was specifically bred for superior traits, including a high growth rate, high survival rate, and high-quality meat and wool production. Mellado *et al*. (2016) reported that Dorper sheep exhibit favourable growth performance, efficient feed utilisation, and desirable carcass characteristics. Dorper sheep can reach a body weight of 36 kg at 110–120 days of age, with adult males weighing 100–120 kg and adult females weighing 60–80 kg (Gavojdian *et al*., 2013). This breed is recognised for its exceptional adaptability to a wide range of climatic conditions, including arid and semi-arid regions. Given these characteristics, crossbreeding between Indonesian local sheep and Dorper represents a promising strategy to enhance the productivity and body conformation of sheep farming in Indonesia.

Morphometric measurements in crossbred sheep play a critical role in supporting the development and productivity enhancement of local livestock. Morphometric data, such as body weight, body length, wither height, and chest girth, not only reflect an individual's genetic potential and growth performance but also serve as essential indicators for phenotypic selection aimed at improving livestock quality. In the context of crossbreeding, morphometric analysis facilitates the identification of heterosis effects and the achievement of breeding objectives, such as enhanced body size, improved feed conversion efficiency, and adaptation to local production environments.

Although several studies have reported the productive performance and adaptability of Dorper sheep in different production systems, information regarding the morphometric characteristics of Dorper crossbred sheep under Indonesian tropical conditions remains limited. In particular, there is still insufficient information on how Dorper genetics influence body conformation traits in local crossbred populations, which are important parameters for selection and breeding programs. Previous studies have mainly focused on growth performance and carcass traits, while comprehensive morphometric evaluations of Dorper crossbred sheep in Indonesia are still rarely reported. This lack of information creates a research gap in understanding the phenotypic potential of Dorper crossbreeding programs under local environmental conditions. Therefore, this study aimed to evaluate the morphometric characteristics of Dorper crossbred sheep reared under Indonesian production conditions to provide baseline information for future selection and breeding strategies to improve local sheep productivity.

METHODS

Experiment Location, Animals, and Management

The experiment was conducted at Mitrarama88 Farm in Pandesari Village, Pujon Sub-district, Malang Regency, East Java, Indonesia (7°50′–8°17′ S and 112°17′–112°57′ E), located at an altitude of approximately 1,100 m above sea level with an average ambient temperature ranging from 18–22°C and relative humidity of 70–85%. This location was selected based on the availability of an established Dorper crossbreeding program with documented breeding records.

This study involved 42 yearling crossbred female sheep produced from crossbreeding between Dorper rams and

Domba Ekor Tipis (DET) ewes. Animals were approximately 10–12 months old with an initial body weight range of 22–38 kg. All animals used in this study were non-pregnant and clinically healthy at the time of data collection. Animals were selected through purposive sampling based on three criteria: (1) availability of animals at the farm with confirmed pedigree records, (2) confirmed good health status verified by veterinary examination (absence of clinical signs of disease, ectoparasites, or nutritional deficiency), and (3) reliable age identification verified by the birth date records maintained by the farm. All 42 animals that met these criteria were included in the study.

Animals were maintained under a semi-intensive management system, in which sheep were housed in elevated slatted-floor pens at night and allowed limited daytime activity within the housing area. Each pen was equipped with feed and water containers, and the pens were cleaned daily to maintain hygiene and reduce disease risk. The feeding regimen consisted of field grass (*Pennisetum purpureum*) provided ad libitum, supplemented with commercial concentrate at approximately 200–300 g/head/day containing approximately 14–16% crude protein. Water was available ad libitum throughout the experimental period. Animals were vaccinated routinely against common infectious diseases and dewormed every three months as part of the farm health management program.

Morphometric Measurements

The following morphometric traits were measured in each animal by the same trained observer to minimise measurement bias and ensure consistency:

1. Body weight (BW): measured using a calibrated digital hanging scale (capacity 150 kg, precision 0.1 kg) and recorded in kilograms (kg).
2. Body length (BL): measured from the base of the neck (at its junction with the body) to the base of the tail using a flexible measuring tape, and recorded in centimetres (cm).
3. Body height (BH): determined as the vertical distance from the ground to the highest point of the shoulder (wither), measured perpendicularly using a measuring stick, and recorded in cm.
4. Chest girth (CG): measured as the circumference around the thoracic cavity, taken just behind the forelimbs, using a flexible tape, and expressed in cm.
5. Hip width (HW): measured as the horizontal distance between the left and right tuber coxae using a Vernier calliper, and recorded in cm.
6. Head length (HeL): measured from the occipital bone to the tip of the snout using a Vernier calliper, and recorded in cm.
7. Head width (HeW): measured across the widest part of the cranium between the two zygomatic arches using a Vernier calliper, and recorded in cm.

Data Analysis

Morphometric data were analysed using descriptive statistics, including mean ($\bar{x}$), standard deviation (SD), minimum and maximum values, and coefficient of variation (CV%). The CV was calculated as:

$$\mathrm{CV}\,(\%) = \frac{\mathrm{SD}}{\mathrm{x}} \times 100$$

To assess within-trait variability in the population. Ninety-five percent confidence intervals (95% CI) were also calculated for each trait to improve statistical interpretation and population estimation accuracy using the following formula:

$$95\%\ \mathrm{CI} = \bar{\mathrm{x}} \pm 1.96 \frac{\mathrm{SD}}{\sqrt{\mathrm{n}}}$$

Where n=42. All statistical computations were performed using Microsoft Excel 2019.

RESULT AND DISCUSSION

The morphometric characteristics of yearling Dorper × DET crossbred female sheep are presented in Table 1. The animals showed considerable variation in body size, as indicated by the coefficient of variation (CV) values ranging from moderate (8–10%) for traits such as body length, chest girth, and body height, to relatively high (>13%) for hip width and head width. This level of variation is biologically expected in crossbred populations, given the segregation of alleles from two genetically distinct parent breeds and the inherent environmental variation under smallholder production conditions. In addition to genetic segregation, variation among individuals may also be influenced by differences in feed intake efficiency, nutrient utilisation, social competition within group housing, and physiological maturity among yearling females. Although all animals were maintained under the same semi-intensive system, individual responses to feeding and management conditions can still contribute to phenotypic variability. High CV values in traits such as hip width may also reflect differential expression of Dorper and DET genetics in individual offspring, as well as variation in nutritional history within the farm.

When compared to the morphometric data reported by Suryani *et al.* (2023) for yearling DET (Domba Ekor Tipis) females, the present Dorper × DET crossbred animals demonstrated notably greater body dimensions: body weight increased by 11.29 kg, body length by 11.17 cm, body height by 2.13 cm, chest girth by 9.14 cm, and hip width by 2.72 cm. Head length, however, was marginally lower by 0.50 cm. Similarly, compared to the findings of Yantoro et al. (2020) for local sheep in Lamongan, the crossbred sheep demonstrated increases in body weight (11.36 kg), body length (5.09 cm), and chest girth (6.79 cm), while body height was 1.39 cm lower. These differences are not only quantitative but also indicate distinct biological responses associated with breed composition and production environment. Dorper sheep are genetically selected for rapid muscle accretion and larger body frame development, which likely contributed to the greater body weight and thoracic development observed in the crossbred animals. Moreover, the semi-intensive production system applied in the present study, combined with concentrate supplementation, may have supported better nutrient availability for skeletal and muscular growth compared with traditional extensive systems commonly reported in local sheep studies. Traits such as body weight and chest girth are directly correlated with meat yield potential, while body length is associated with overall frame size and carcass length, all commercially important traits in meat sheep production.

Table 1. Mean, standard deviation, minimum, maximum, coefficient of variation, and 95% confidence intervals of morphometrics measurements of yearling female crossbred of Dorper x DET sheep

Parameter	Mean	Max	Min	CV (%)	95% CI
Body weight (BW)	28.89±4.10 kg	36.50 kg	21.70 kg	14.18	27.65 – 30.13 kg
Body length (BL)	60.67±5.37 cm	65.80 cm	46.00 cm	8.85	59.05 – 62.29 cm
Body height (BH)	53.93±4.87 cm	60.20 cm	43.00 cm	9.03	52.46 – 55.40 cm
Chest girth (CG)	69.34±5.94 cm	74.60 cm	56.00 cm	8.57	67.54 – 71.14 cm
Hip width (HW)	17.82±3.17 cm	22.00 cm	10.10 cm	17.82	16.86 – 18.78 cm
Head length (HeL)	14.70±1.44 cm	17.10 cm	11.00 cm	9.77	14.26 – 15.14 cm
Head width (HeW)	14.22±1.88 cm	18.00 cm	9.00 cm	13.21	13.65 – 14.79 cm

From a physiological standpoint, the enhanced body weight and chest girth observed in the crossbred animals likely reflect improved growth potential associated with the introduction of Dorper genetics rather than heterosis alone (Besufkad *et al*., 2023). Chest girth is closely associated with thoracic volume, lung capacity, and rumen size, all of which contribute to improved respiratory efficiency and nutrient processing capacity (Wang *et al*., 2024). A larger rumen volume enables greater forage intake and fermentation capacity, thereby enhancing the digestibility of fibrous feeds and supporting more efficient nutrient partitioning toward lean tissue deposition. Furthermore, Dorper sheep are known for their efficient feed conversion and capacity to maintain growth under moderate nutritional conditions, which may partially explain the superior body development observed in the crossbred animals. The physiological status of the animals may also have contributed to measurement consistency, as all females used in this study were non-pregnant yearlings, thereby minimising variation associated with gestation-related body changes. These functional advantages are particularly relevant under smallholder production systems, where feed resources are often variable and nutritional management is less precise. Additionally, the improved body length and hip width in the crossbred animals suggest more favourable skeletal development, which may contribute to reproductive longevity and ease of parturition in breeding females.

Interestingly, head length was slightly lower in the crossbred females compared to DET purebreds. This may reflect the genetic contribution of the Dorper sire, which characteristically exhibits a more compact, rounded head morphology and a shorter facial profile compared to many Indonesian local breeds. In F1 crossbreds, head morphology may express intermediate phenotypes or, depending on dominance relationships at specific loci, may lean toward either parent. The marginally reduced head length does not negatively affect productive performance, as cranial dimensions are generally not directly associated with meat yield or growth efficiency compared to body weight, body length, and chest girth. The wider head width observed in the present study (14.22 cm) is consistent with the broader facial structure of Dorper-influenced offspring and may indicate a stronger brachycephalic influence from the sire breed.

When compared with published morphometric values for pure Dorper females which commonly attain 60–80 kg with correspondingly greater body height and chest girth (Gavojdian *et al*., 2013) the F1 crossbred animals in this study still exhibited relatively smaller body dimensions. This is an expected outcome in F1 crossbreeding, as the F1 phenotype represents an intermediate expression of both parent breeds. The observed intermediate phenotype suggests additive genetic contributions from both Dorper and DET breeds, with the local DET background helping preserve environmental adaptability while the Dorper component contributing to increased body size and muscling capacity. Environmental conditions, feeding management, and the tropical production system may also limit the full phenotypic expression of the Dorper genotype compared with performance reported under intensive systems in subtropical regions. This intermediate performance, however, already represents a substantial improvement over the DET purebred, demonstrating the genetic leverage achievable through a single round of crossbreeding.

The observed morphometric improvements are consistent with the established literature on crossbreeding effects in small ruminants. Latorre *et al*. (2011) and Pramujo *et al*. (2025) documented that crossbred sheep generally outperform purebred local animals in morphometric traits. However, the present study did not include simultaneous purebred parental

controls; therefore, the observed superiority of the crossbred animals should not be interpreted as direct evidence of heterosis. Instead, the results indicate that the incorporation of Dorper genetics was associated with improved body conformation traits compared with previously published local sheep references. These improvements may be partially related to positive heterotic responses reported in previous crossbreeding studies, where F1 offspring showed enhanced growth and body development relative to parental averages (Maylinda, 2010). In the present study, the absence of simultaneous purebred control groups (both Dorper and DET) means that heterosis cannot be formally calculated. The improvements observed, however, are directionally consistent with positive heterotic effects reported by Tesema *et al*. (2023) for Awassi × Dorper crosses, Deng *et al.* (2020) for Dorper × thin-tailed Han crosses, and Jurado *et al.* (2022) for Dorper crossbreds under diverse production environments. Future studies should include purebred parental controls to formally estimate heterosis percentages for each morphometric trait. Furthermore, Santos *et al*. (2020) documented favourable body conformation and reproductive characteristics in F1 Dorper × Santa Inês ewes, suggesting that the productive and reproductive advantages of Dorper crossbreeding are consistent across geographically diverse production systems.

The assessment of morphometric traits in yearling sheep holds strategic value in livestock breeding and production management. The yearling stage is considered a physiological phase during which genetic expression of body size traits becomes clearly evident, as the growth trajectory transitions from an accelerating to a more stable phase. At this age, traits such as body height, body length, and chest girth not only reflect prior growth performance but also serve as predictors of future meat production efficiency and reproductive success (Illa *et al*., 2024). From a practical standpoint, the yearling stage in Indonesian smallholder systems typically coincides with the marketing or culling decision point, making morphometric measurements directly relevant to economic valuation of livestock. The measurements obtained at this stage can also be used to estimate breeding values, identify superior sires and dams for the next generation, and calibrate growth prediction models (Walle, 2019; Haddad *et al*., 2025). Deribe *et al*. (2023) demonstrated that growth curve analysis at the yearling stage can identify genotype-specific growth patterns that inform selection decisions. Therefore, routine and standardized morphometric assessment at one year of age should be integrated into smallholder sheep management protocols as a low-cost, non-invasive tool for genetic monitoring and production optimization.

CONCLUSION

The present study demonstrated that Dorper × Domba Ekor Tipis (DET) crossbred female sheep reared under smallholder farming conditions exhibited favourable morphometric characteristics, indicating the potential contribution of Dorper genetics to improving body conformation traits in local Indonesian sheep populations. From a practical perspective, morphometric evaluation at the yearling stage can serve as a simple, low-cost tool for selecting superior breeding stock in smallholder production systems. However, because this study relied primarily on descriptive analysis and comparisons with published references, the observed differences should be interpreted cautiously and not as definitive evidence of heterosis or statistically validated superiority. Future studies should incorporate purebred parental controls, larger sample sizes, and inferential statistical analyses, and should also evaluate multi-generational performance under different feeding and management conditions to support the development of sustainable Dorper-based breeding programs in Indonesia.

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