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Clustering of Dam's Body Weight Based on Birth Weight of Lambs in Nilagiri Sheep

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ABSTRACT

The population of Nilagiri breed of Sheep is threatened and required micro breeding strategy for conservation and genetic improvement. Data on 4,619 Nilagiri lambs born during the 28 years (1993-2021) at the Sheep Breeding Research Station (SBRS), Sandynallah of the Nilgiris district, Tamil Nadu, India were utilized for this investigation. Data on birth weight of lamb along with dam's body weight at the time of lambing were collected. Relationship between different body weights of dam was investigated in terms of lamb's birth weight using one-way ANOVA followed by post hoc test for different dam body weight pairwise comparison. Heatmap was drawn for P values between different dam's body weights aiding in visualization of the possible compatibility between body weights of dam. The birth weight of lambs positively correlated with that of dam's body weight. Heat map visual analysis revealed five different clusters *viz.*<23.00 kg, 23.01-26.00 kg, 26.01-29.00 kg, 29.01-32.00 kg and > 32.01 kg sets of patterns. This was the first study in sheep breed for applying heatmap tool for growth trait analysis.

Key words: Birth weight, Cluster, Dam body weight, Heat map, Nilagiri sheep.

India has 74.26 million sheep with second-largest population of sheep in the world (BAHS, 2019). It has 44 distinct breeds of sheep spread across the country's diverse agro climatic zones (NBAGR, 2023). Domestic animal's growth rate is a valuable economic characteristic since it reflects the animal's adaptability and farmer's monetary benefit. In South India, sheep is mainly raised for the production of mutton. Hence body weight is one of the economically important character. Body weight at market age is ultimately determined by their rapid growth rate and this can be used as a major selection criterion. A strong and favourable association between birth weight and dam weight shows that boosting dam weight through better nutrition and pregnancy management can significantly increase lamb's birth weight (Joesfina *et al*., 1980 and Khan *et al*., 2011).

The birth weight of the lambs and the weight of the dam at service had a strong positive correlation and regression relationship (Hussain *et al*., 2000). There were no prior investigations on the impact of dam weight on lamb birth weight in Nilagiri sheep.

Cluster heat maps and correlation plots are two existing graphical techniques for investigating association in many variables. Two-dimensional display of a two by two data matrix gave rise to heat maps. In cluster heat map, darker squares denoted higher numbers, whereas lighter squares represented lower values (Haarman *et al*., 2015). There was no previous report on heat map clustering data analysis for sheep breeds. Cluster heat maps are helpful at identifying groups of correlated samples (Engle *et al*., 2016). Cluster heat maps are particularly useful for locating clusters of associated samples or genes when applied to a correlation matrix. These groups can spot outliers, tissue subtypes and new gene pathways since they are displayed as diagonal block structures (Zhao *et al*., 2014).

The present study was conducted in the Veterinary University Training and Research Centre, Tamil Nadu Veterinary and Animal Sciences University, Tirupur during March 2021 to January 2023.

The data for the present investigation were collected from the Sheep Breeding Research Station (SBRS), Sandynallah of the Nilgiris district, Tamil Nadu, India. Data on 4,619 Nilagiri lambs born during the last 28 years (1993-2021) at the SBRS were utilized for this investigation. Data on birth weight of lamb along with dam's body weight at the time of lambing were collected particularly in single lamb birth. Dams were grouped into 28 groups based their body weight.

This work investigated the relationship between different body weights of dam at the time of lambing in terms of lamb's

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birth weight. For this purpose, using lamb's birth weight as a continuous variable, we calculated the one-way ANOVA followed by post hoc test for different dam body weight pairwise comparison. Heat map was drawn for P values between different dam's body weights. A heat map with 2-way clustering of these P values for pairwise tests aids in visualization of the possible compatibility between body weights of dam.

The average birth weight of Nilagiri lambs at different dam's weight is presented in Table 1.The result revealed that the birth weight of lambs positively correlated with that of dam's body weight.

The lowest mean birth weight among Indian breeds was 1.29 kg for Keezhakkaraisal (Ganesakale and Rathnasabapathy, 1973) and the highest as 3.55 kg for Muzaffarnagri sheep (Dass *et al*., 2014). While the birth weight of Nilagiri sheep ranged from 2.37 to 3.15 kg, the reported birth weight for Nilagiri Synthetic sheep (Sandyno) ranged from 2.56 kg to 2.81 kg (Rajendran, 2005; Venkataramanan *et al*., 2015). In this investigation, the higher range of 3.15 kg in birth weight was observed when the ewes weight averaged between 35 to 36 kg and thereafter the difference was not much appreciated as the no of observations were also less.

In the heatmap, each square gives the pairwise P value for dam's body weight in the corresponding row with the dam's body weight in the corresponding column in terms of their lamb's birth weight (Fig 1). Heat map of P values of the post hoc LSD were used to more thoroughly test which dam's body weight were identical by a coloured matrix. Such heat maps display the information about the similarity of body weight as not significance/significance at different level by sharing a common colour.

Table 1: Mean (±SE) birth weight of lamb at different dam's weight in Nilagiri sheep.

Dam's weight (kg)	Birth weight (kg)
≤18	1.900±0.079 (57)
19	2.052±0.056 (48)
20	2.195±0.046 (107)
21	2.226±0.043 (127)
22	2.267±0.031 (234)
23	2.340±0.041 (349)
24	2.451±0.026 (340)
25	2.518±0.024 (398)
26	2.560±0.026 (382)
27	2.639±0.025 (379)
28	2.693±0.026 (378)
29	2.697±0.027 (368)
30	2.827±0.029 (312)
31	2.834±0.033 (249)
32	2.955±0.036 (223)
33	2.966±0.042 (166)
34	2.991±0.041 (127)
35	3.100±0.048 (103)
36	3.131±0.060 (77)
37	3.075±0.064 (64)
38	3.116±0.080 (38)
39	3.342±0.114 (26)
40	3.308±0.116 (26)
41	3.300±0.194 (13)
42	3.312±0.140 (8)
43	3.456±0.193 (9)
44	3.560±0.211 (5)
≥45	3.317±0.369 (6)

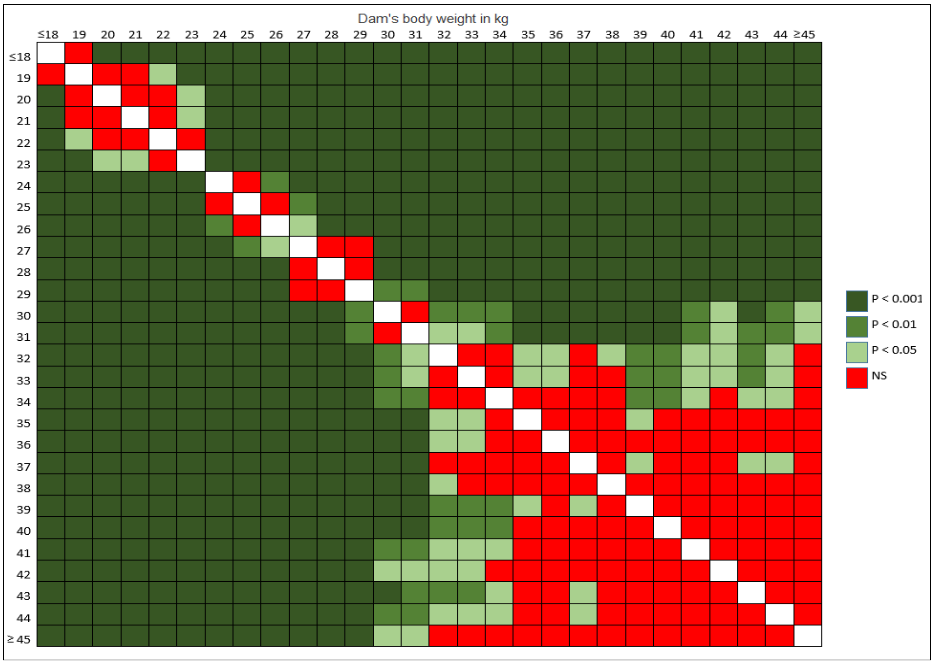

Fig 1: P value Heat map of the lamb birth weight at different dam's body weight at the time of lambing in Nilagiri sheep.

Cluster heat map give the pairwise P value for all the possible pairs of dam's body weight so that the rows and columns are by definition symmetric. The colour of cell indicates the P value of the pairwise comparison and the intensity of the green colour increases proportionally with the level of significance. More precisely, clusters for body weight of dam are created by red colour cell patterns of compatibility (Fig 1) indicating that there is evidence that the 2 body weights of dam could share a common cluster. A light or dark-green–coloured cell indicates pairs of dam's body weight that differ significantly for lamb's birth weight with most other dam's body weight.

Thus, heatmaps of P values matrices are particularly helpful for identifying blocks or clusters or subgroups of similar types samples (Engle *et al*., 2016). Visual analysis of heat map (Fig 1) revealed five different clusters *viz.* <23.00 kg, 23.01-26.00 kg, 26.01-29.00 kg, 29.01-32.00 kg and > 32.01 kg sets of patterns. No report available on heatmap tool used for data analysis in livestock species for comparison. This study was the first in sheep applying heatmap tool in growth trait analysis. The present study is an attempt to ascertain the efficiency of heatmap clustering tool for data analysis, especially the effect of dam weight on birth weight of lambs, so as to initiate steps in providing better nutritional and managemental interventions for impressing the overall productivity in sheep farm.

CONCLUSION

The results showed a significant association between lamb birth weight and their dam body weight at the time of lambing. There was a positive correlation between lamb birth weight and dam body weight. The heat map revealed the dam body weight clusters according to their lamb birth weight. The heat map helped in sub grouping of dam according to their lamb's birth weight and thus can be used as a significant factor during genetic and nongenetic analysis of growth traits for the selection at early age of future breeding sheep.

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Conflict of interest: None.

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