

EFFECT OF TEMPERATURE AND TEMPERATURE HUMIDITY INDEX ON GROWTH PERFORMANCE OF SANGAMNERI GOAT

S. D. MANDAKMALE, P. B. BHOSALE AND S. R. SHENDAGE

*All India Coordinated Research Project on Goat Improvement (Sangamneri Field Unit)
Mahatma Phule Krishi Vidyapeeth Rahuri - 413722, Maharashtra
E-mail address: mandakmale@gmail.com*

Abstract: Data on body weights at birth, 3, 6, 9, 12 months of age of Sangamneri local kids born between 2008 to 2015 at All India Coordinated Research Project On Sangamneri goat, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra); were collected and subjected to least-squares analysis to determine the effect of year and season of birth, temperature and Temperature Humidity Index (THI) groups on body weight at different ages. The overall least-squares means for weight at birth, 3,6,9 and 12 month of age were 2.13 ± 0.014 , 7.48 ± 0.07 , 10.22 ± 0.08 , 12.44 ± 0.12 and 14.74 ± 0.19 kg respectively. The year and season of birth had a significant ($P < 0.01$) effect on birth weight. Significantly ($P < 0.01$) highest birth weight 2.22 ± 0.03 kg was noticed in the kids born during the year 2013. Temperature and THI had non-significant ($P < 0.01$) effect on birth weight. Effects of year and season of birth were significant ($P < 0.01$) on 3, 6 and 9 months body weight while the year of birth had significant ($P < 0.01$) and season of birth had non-significant effect on 12 months body weight. The maximum and minimum temperature showed non-significant influence on body weights at different ages under study, except 6 month body weight which was affected significantly ($P < 0.01$) by minimum temperature. The THI showed non-significant influence on body weights at different ages under study except 6 month body weight, indicated that Sangamneri breed of goat can withstand in high temperature and THI variation.

INTRODUCTION

'Sangamneri' is one of the important goat breeds of India. The name of the breed is derived from its habitat i.e. Sangamner tehsil of Ahmednagar district and found in Ahmednagar, Pune and Nashik district of Maharashtra. The breed is hardy with strong disease resistance potential, used for milk and meat purpose. However due to encroachment of other Indian and exotic breeds the population of Sangamneri goat was declined to a threatened level in 2003. The AICRP on Goat, Sangamneri field unit is working in genetic improvement through selection, breeding and up-gradation to conserve this threatened breed since 2002. The global warming and climate change have enforced us to study the performance of this breed in heat stress. A number of

changes occur in the animal as a result of heat stress including direct effects such as effects on animal health, growth, production and reproduction and indirect effects such as effect on livestock pastures, forage crop production, biodiversity, and emergence or re-emergence of livestock diseases. Growth performance is an important basis to judge goat breed efficiency. The temperature has its effect on feed intake, respiratory rate, weight and water consumption while THI is used to evaluate the effect of heat stress on dairy animals and to improve the efficiency of management strategies to alleviate the negative effect of heat stress. So, the present study was conducted to observe the effect of temperature and temperature humidity index (THI) on growth performance of Sangamneri goat.

MATERIALS AND METHODS

The data pertains to body weights of Sangamneri kids maintained at All India Co-ordinated Research Project on Goat Improvement (Sangamneri field unit) M.P.K.V., Rahuri-413722, Maharashtra during the year 2008 to 2015 was collected for the present study. The project comes under semi-arid scarcity zone of Maharashtra state, having altitude of 559 meters and it is on 18°31' North latitude and 71°51' east longitude. The study area of the project was breeding tract of Sangamneri goat which includes part of Ahmednagar, Nashik and Pune district. Body weights of kids recorded at different stages of growth like weight at birth, 3, 6, 9 and 12 months of age. The maximum temperature, minimum temperature and THI were ranged in the groups i.e. T. max.1 (<25°C), T. max.2 (25-30°C), T. max.3 (30-35°C), T. max.4 (35-40.°C) and T. max.5 (>40°C); T. min.1 (<10°C), T. min.2 (10-15°C), T. min.3 (15-20°C) and T. min. 4 (>20°C); THI₁ (<80), THI₂ (80-83), THI₃ (83-86), THI₄ (86-89), and THI₅ (>89) respectively. THI were calculated, by adopting National Research Council Formula (NRC, 1971).

$$\text{THI} = [1.8 \times (\text{Tdb}) + 32] - (0.55 - 0.0055 \times \text{RH}) \times [1.8 \times (\text{Tdb}) - 26]$$

Where,

Tdb = Dry bulb temperature (°C),

RH = Relative humidity

The data were analyzed by adopting the least-squares technique (Harvey, 1990) to estimate the effects of year of birth, season of birth, temperature and THI on growth performance.

RESULTS AND DISCUSSION

The average birth weight of Sangamneri kids was 2.13 ± 0.014 kg (Table 1). The year of birth and season of birth had significantly ($P < 0.01$) influenced the birth weight of kids. The kids born in the year 2013 were heavier (2.24 ± 0.03 kg) than that of year 2008 (2.01 ± 0.04 kg), 2009 (2.09 ± 0.04) and 2014 (2.08 ± 0.03 Kg). Kids born in rainy season were significantly ($P < 0.01$) heavier (2.17 ± 0.02 kg) than summer (2.13 ± 0.02 kg) and winter season (2.09 ± 0.02 kg). A similar significant effect of year of birth on birth weight was reported by Dhere (2016) in Sangamneri

kids, Jedhe *et al.* (2009) in Osmanabadi goats, Ekambaram *et al.* (2010) in Mahabubnagar goats, Ruvenkadan *et al.* (2009) in Tellicherry goats and Bharatidhasan *et al.* (2009) in Barbari goats. Effect of season of birth on birth weight were in agreement with the results reported by Das *et al.* (2013) in Assam local goats, Kumar *et al.* (2005) in Tellicherry goats and Dhere (2016) in Sangamneri kids. However, the non-significant effect of season of birth on birth weight was observed by Gupta *et al.* (2016) in Mehsana goats and Sharma *et al.* (2010) in Sirohi goats. Influence of maximum & minimum temperature and THI on birth weight was found to be non-significant in Sangamneri kids. However, the significant effect of THI was observed by Dhere (2016) in Sangamneri kids.

Three months body weight of Sangamneri kids was 7.48 ± 0.07 kg (Table.1). Effect of year of birth and season of birth was significant on three months body weight of kids. Kids born during year 2012 were significantly heaviest (8.55 ± 0.18 kg) while those born in 2008 and 2009 were lightest (6.29 ± 0.23 and 6.28 ± 0.26 kg) while summer season born kids were significantly heavier (8.00 ± 0.13 kg) than rainy season (7.10 ± 0.15 kg) and winter season (7.34 ± 0.11 kg) born kids at three months body weight. Results regarding effect of year of birth on 3 month body weight reported by Dhere (2016) in Sangamneri kids, Ekambaram *et al.* (2010) in Mahabubnagar goats, Bharatidhasan *et al.* (2009) in Barbari goats, Gupta *et al.* (2016) in Mehasana goats, Sharma *et al.* (2010) in Sirohi goats and Vasave *et al.* (2010) in Sangamneri goats coincides with present study. Results regarding effect of season of birth on 3 month body weight reported by Dhere (2016) in Sangamneri kids, Jedhe *et al.* (2009) (7.06 ± 0.84 kg) in Osmanabadi goats, Das *et al.* (2013) (5.84 ± 0.10 kg) in Assam local goats are similar with this study. However, Ekambaram *et al.* (2010) (8.7 ± 0.08 kg) in Mahabubnagar goats reported contradictory findings. Effect of maximum & minimum temperature and THI on 3 month body weight was found to be non-significant in Sangamneri kids (Table.2). However, the significant effect of THI was observed by Dhere (2016) in Sangamneri kids. Similar results regarding effect THI on 3 month body weight

were reported by Dhere (2016) in Sangamneri kids. However, significant effect was obtained by Okoruwa (2014) in dwarf goats in Southern Nigeria.

Overall six months body weight of Sangamneri kids in present study was 10.22 ± 0.08 kg (Table.1). The year of birth and season of birth showed significant influence on the six months body weight of Sangamneri goat. Kids born in the year 2015 were heavier (11.77 ± 0.27 kg), while those born in year 2009 were significantly lighter (8.73 ± 0.31 kg) at 6 months body weight. Similar findings were reported by Thiruvankadan *et al.* (2009) in Tellicherry goats, Bhusan (2012) in Jakhrana kids, Rathod *et al.* (2011) in Osmanabadi goats and Dhere (2016) in Sangamneri kids. Winter season born kids were significantly heavier (10.65 ± 0.12 kg) than those born in the rainy season (9.71 ± 0.17 kg) and summer season (10.29 ± 0.15 kg). It might be due to the access to good quality grazing land in comparison to other seasons of the year.

Similar results were obtained by Dhere (2016) in Sangamneri kids, Das *et al.* (2013) in Assam local goats. However, Ekambaram *et al.* (2010) in Mahabubnagar goats, Gupta *et al.* (2016) in Mehasana goats reported contradictory findings. Effect of maximum & minimum temperature on 3 month body weight was found to be non-significant in Sangamneri kids. Significant effects of THI on six months body weight of Sangamneri kids were noticed (Table.2). Significantly highest birth weight (kg) were noticed in the kids born under <80 (11.39 ± 0.560 kg) while significantly lowest birth weights are noticed in the kids born under >89 (9.32 ± 0.348 kg). However, contradictory results were reported by Dhere (2016) in Sangamneri kids.

The overall mean for nine months body weight in Sangamneri kids was 12.44 ± 0.12 kg (Table.1). The year of birth and season of birth showed significant effect on the nine months body weight. Kids born in year 2012 were heaviest (14.43 ± 0.28 kg) and those born in 2009 were lightest (10.66 ± 0.49 kg) in weight while the nine months body weights were highest in the rainy season (12.91 ± 0.23 kg) and lowest in summer season (11.83 ± 0.22 kg). The result for association of effect of year of birth for

nine months body weight was in agreement with Jedhe *et al.* (2009) in Osmanabadi goat, Thiruvankadan *et al.* (2009) in Tellicherry goats, Bhusan (2012) in Jakhrana kids and Dhere (2016) in Sangamneri kids. Significant effect of season of birth on nine months body weight is also reported by Dhere (2016) in Sangamneri kids, Rathod *et al.* (2011) in Osmanabadi goats, Gupta *et al.* (2016) in Mehasana goats. However, Ekambaram *et al.* (2010) in Mahabubnagar goats reported contradictory findings. The influence of maximum temperature on nine months body weight was non-significant in Sangamneri kids (Table.2). The highest body weight (kg) was observed at $<25^{\circ}\text{C}$ (13.24 ± 2.123 kg) while the lowest body weight was observed at $25-30^{\circ}\text{C}$ (11.29 ± 0.376 kg). However, a significant effect of minimum temperature on nine month body weight of Sangamneri kids was noticed. Significantly highest body weight (kg) were noticed in the kids born under $>20^{\circ}\text{C}$ (12.91 ± 0.479 kg) which was at par with the kids born under $<10^{\circ}\text{C}$ and $10-15^{\circ}\text{C}$. However, significantly lowest birth weight was noticed in the kids born under $15-20^{\circ}\text{C}$ (11.89 ± 0.520 kg). The influence of THI on nine month body weight was non-significant in Sangamneri kids. The highest nine month body weight (kg) was observed at <80 (12.88 ± 0.718 kg) while the lowest at >89 (11.98 ± 0.704 kg). Similar results were reported by Dhere (2016) In Sangamneri kids.

The overall mean twelve months body weight of Sangamneri kids in present study was 14.74 ± 0.19 kg (Table.1). The effect of year of birth was significant on twelve months body weight of Sangamneri goats. The kids born during year 2012 were heaviest (17.02 ± 0.41 kg), while those born in year 2009 were lightest (12.53 ± 0.87 kg) in twelve months body weight. Similar results were reported by Dhere (2016) in Sangamneri kids, Jedhe *et al.* (2009) in Osmanabadi goat, Gupta *et al.* (2016) in Mehasana goats. However, Bhusan (2012) in Jakhrana kids shown non-significant effect of year of birth on twelve months body weight. The variations in twelve months body weight for rainy (14.85 ± 0.32 kg), winter (14.63 ± 0.27 kg) and summer (14.76 ± 0.29 kg) season born kids were non-significant. The results were in agreement with the findings of Dhere (2016)

in Sangamneri kids, Ekambaram *et al.* (2010) in Mahabubnagar goats. Whereas, Gupta *et al.* (2016) in Mehasana goats, Rathod *et al.* (2011) in Osmanabadi goats reported significant effect of season of birth on twelve months body weight. The influence of maximum and minimum temperature on twelve months body weight was non-significant (Table 2). The highest body

Table 1: Least square means for body weight of Sangamneri goats as affected by various non genetic factors

Sr. No.	Source of variation	Body weights at									
		Birth		3 months		6 months		9 months		12 months	
		N	Mean ± S.E	N	Mean ± S.E	N	Mean ± S.E	N	Mean ± S.E	N	Mean ± S.E
	μ	911	2.13±0.014	911	7.48±0.07	911	10.22±0.08	595	12.44±0.12	422	14.74±0.19
	Year of birth										
1	2008	99	2.01±0.04 ^{bc}	99	6.29±0.23 ^f	64	8.73±0.31 ^{ef}	-	-	-	-
2	2009	64	2.09±0.04 ^{bc}	64	6.28±0.26 ^f	138	9.13±0.21 ^{ef}	33	10.66±0.49 ^e	14	12.53±0.87 ^c
3	2010	138	2.15±0.03 ^{ab}	138	7.35±0.18 ^{cd}	166	9.38±0.19 ^e	74	11.87±0.33 ^{cd}	48	14.43±0.48 ^b
4	2011	166	2.18±0.03 ^{ab}	166	7.25±0.16 ^d	132	11.54±0.21 ^{ab}	122	11.98±0.25 ^c	82	14.91±0.36 ^b
5	2012	132	2.14±0.03 ^{ab}	132	8.55±0.18 ^a	124	10.18±0.22 ^{bc}	100	14.43±0.28 ^a	65	17.02±0.41 ^a
6	2013	124	2.24±0.03 ^a	124	7.74±0.19 ^{cd}	110	10.73±0.23 ^{bc}	104	12.38±0.27 ^{ab}	86	15.04±0.35 ^b
7	2014	110	2.08±0.03 ^{bc}	110	7.90±0.20 ^{bc}	78	11.77±0.27 ^a	102	12.51±0.28 ^{ab}	85	14.70±0.35 ^b
8	2015	78	2.17±0.04 ^{ab}	78	8.48±0.23 ^{ab}	64	8.73±0.31 ^{ef}	60	13.25±0.36 ^{ab}	42	14.59±0.50 ^b
	Season of birth										
1	Rainy	209	2.17±0.02 ^a	209	7.10±0.15 ^b	209	9.71±0.17 ^b	163	12.91±0.23 ^a	115	14.85±0.32
2	Winter	410	2.09±0.02 ^b	410	7.34±0.11 ^{ab}	410	10.65±0.12 ^a	243	12.58±0.18 ^a	162	14.63±0.27
3	Summer	292	2.13±0.02 ^{ab}	292	8.00±0.13 ^a	292	10.29±0.15 ^a	189	11.83±0.22 ^b	145	14.76±0.29

(P<0.01)

The means under each class in the same column with different superscripts differed significantly.

Table 2: Least squares means for body weight (kg) of Sangamneri goat affected by Temperature and THI

Sr. No.	Source of variation	Body weights at									
		Birth		3 months		6 months		9 months		12 months	
		N	Mean ± S.E	N	Mean ± S.E	N	Mean ± S.E	N	Mean ± S.E	N	Mean ± S.E
	μ	911	2.07±0.052	911	7.32±0.147	911	10.12±0.204	594	12.44±0.507	422	15.21±0.759
	Temperature maximum (°C)										
1	< 25	3	2.05±0.23	-	-	-	-	2	13.24±2.123	1	13.93±3.277
2	25 - 30	231	2.07±0.039	94	7.23±0.299	166	9.73±0.299	108	11.29±0.376	81	14.06±0.483
3	30 - 35	549	2.08±0.030	524	7.28±0.172	433	10.18±0.193	351	12.39±0.249	267	14.91±0.346
4	35 - 40	90	2.08±0.054	216	7.39±0.219	294	10.55±0.251	126	12.59±0.382	70	14.73±0.538
5	< 40	38	2.08±0.088	77	7.39±0.336	18	10.01±0.625	7	12.03±1.147	3	18.47±1.977
	Temperature Minimum (°C)										
1	< 10	42	2.07±0.102	21	6.79±0.553	33	9.30±0.654	19	12.45±0.953 ^{ab}	20	14.45±1.119
2	10 - 15	336	2.07±0.051	316	7.20±0.169	162	10.23±0.262	132	12.50±0.515 ^{ab}	174	14.94±0.823
3	15 - 20	233	2.07±0.052	171	7.69±0.228	108	10.40±0.302	129	11.89±0.520 ^{bc}	70	15.59±0.871
4	< 20	300	2.08±0.050	403	7.60±0.151	608	10.54±0.225	314	12.91±0.479 ^a	158	15.87±0.805
	THI										
1	< 80	75	2.09±0.071	59	7.75±0.405	52	11.39±0.560 ^a	28	12.88±0.718	38	16.23±0.986
2	80 - 83	312	2.08±0.066	255	7.49±0.251	152	10.54±0.348 ^{ab}	183	12.59±0.610	156	14.91±0.850
3	83 - 86	348	2.07±0.067	247	7.24±0.243	290	9.55±0.307 ^{bc}	199	12.28±0.621	120	14.74±0.883
4	86 - 89	91	2.07±0.072	199	7.07±0.255	198	9.79±0.345 ^{ab}	100	12.45±0.650	75	15.47±0.874
5	> 89	85	2.07±0.086	151	7.05±0.295	219	9.32±0.348 ^{bc}	84	11.98±0.704	33	14.71±1.023

(P<0.01)

The means under each class in the same column with different superscripts differed significantly.

weight (kg) was observed at $>40^{\circ}\text{C}$ (18.47 ± 1.977 kg) while the lowest body weight was observed at $<25^{\circ}\text{C}$ (13.93 ± 3.277 kg). At minimum temperature highest birth weight was observed at $>20^{\circ}\text{C}$ (15.87 ± 0.805 kg) and the lowest body weight was observed at $<10^{\circ}\text{C}$ (14.45 ± 1.119 kg). The influence of THI on twelve month body weight was non-significant. The highest twelve month body weight was observed at <80 (16.23 ± 0.986 kg) while the lowest at >89 (14.71 ± 1.023 kg). Similar findings were reported by Dhere (2016) in Sangamneri kids.

The result of this study concludes that the year and season of birth exerted significant influence on body weight at different stages. The effects of temperature and THI on body weights were non-significant which indicated that the Sangamneri goats are well acclimatized to the varying temperature and THI conditions available.

References

- Bharatidashan, A., Rita Narayanan, P. Gopu, A. Subramanian, R. Prabakaran and R. Rajendran, 2009. Effect of non-genetic factors on birth weight, weaning weight and preweaning gain of Barabari goat. *Tamilnadu J. Vet. and Anim. Sci.* 5:99-103.
- Bhusan S. 2012 Effect of non-genetic factors on body weights of Jakhrana kids. *Indian J. of Small Rumi.* 18:253-255.
- Das B., Das D., Aziz A., Kalita D., Roy T. C. 2013. Studies on body weights of assam local and assam local crossbred goats. *Tamilnadu J. Veterinary and Ani. Sci.* 9(4): 292-295.
- Dhere 2016. Influence of Thermohumidity Index on growth performance of Sangamneri kids. M.Sc thesis submitted to M.P.K.V., Rahuri.
- Ekambaram, B., B. Ramesh Gupta, M. Gnana Prakash, K. Sudhaker and V.R.Reddy, 2010. A study on the performance of Mahabubnagargoats. *Indian J. Anim. Res.*, 44(1): 48-51.
- Gacula, M. C., Gount, S. N. and Demon R. A. 1968. Genetic and Environmental parameters of milk constituents for five breeds. Effect of herd-year-season and age of cow. *J. Dairy Sci.* 51(3): 428-437.
- Gupta J. P., Pandey D. P., Shah R. R. 2016. Genetic studies on growth traits of Mehsana goat of Gujrat, India. *Indian J. of Ani. Res.*, 50(2): 164-167.
- Harvey, W. R. 1990. Users guide for LSMLMW PC-2 Version. Mixed Model Least Squares and Maximum Likelihood Computer Program, USA, ARS.
- Jedhe A. R., Lawar V. S., Deokar D. K., Bhoite U. Y., Chechare R. A. 2009 Effect of genetic and non genetic factors on growth traits of Osmanabadi goats. *The Asian J. Ani. Sci.* 4(1): 69-72.
- Kumar G., Thiruvankadan A. K., Karunanithi K. 2005 Factors affecting growth traits of Tellichery kids in different seasons. *Ind. J. of Small Rumi.* 11(1): 88-91.
- Okoruwa, M. I. 2014. Effect of heat stress on thermoregulatory, live bodyweight and physiological responses of dwarf goats in southern Nigeria. *European Scientific Journal September 2014.* Edition Vol.10, No.27 issn: 1857 - 7881
- Rathod S. P., Deokar D.K., Deshmukh A. R., Lokhande A. T. 2011. Studies on post weaning body weight and body measurements of Osmanabadi goats. *Indian J. of Fundamenatal and applied Sci.* 1(4):281-285.
- Sharma, M.C., Pathodiya, O.P., Tailor, S.P., and Mishra S. 2010. Pre-weaning growth traits of Sirohi kids under farmers management system *Ind. J. of Small Rumi.* 16(1): 243-243.
- Thiruvankadan, A.K., Murugan, M., Karunanithi, K., Muralidharan, J. and Chinnamani, K. 2009. Genetic and non-genetic factors affecting body weight in Tellichery goats. *South African J. of Anim. Sci.* 39 (supplement 1).
- Vasave V. M. Lawar, V. S., Pisal Jayashri U., Shinde Swati D., Deokar, D. K. 2010. Studies on three months body weight of Sangamneri kids under field conditions. *The Asian J. of Ani. Sci.* 5(2): 144-146.