VETERINARY RESEARCH INTERNATIONAL
Journal homepage: www.jakraya.com/journal/vri

ORIGINAL ARTICLE

Effect of Spring and Winter Seasons on Growth Performance of Nili Ravi Male and Female Calves at Farm of ICAR-CIRB, Sub Campus, Bir Dosanjh, Nabha (Punjab)

Ashwani Kumar Saini and Ram Singh*

Buffalo Nutrition Division ICAR-Central Institute for Research on Buffaloes, Hisar-125001 (Haryana), India.

*Corresponding Author:

Ram Singh
Email: carirsingh@yahoo.co.in

Received: 13/07/2020
Accepted: 21/08/2020

Abstract

The present investigation was undertaken to study the effect of winter and spring seasons on growth performance of male and female Nili Ravi buffalo calves. The various observations pertaining to male and female calf birth weight, date of birth, calf No., initial age in days from the start of fortnightly body weight (F0) and subsequently fortnightly body weights (F1 to F6) during winter and spring seasons were recorded. The average daily weight gain (F1 to F6), of 766.66, 281.33, 352.66, 505.33, 246.0 and 308.68 g in female calves in spring and average daily weight gain (F1 to F5) of 394.66, 288.66, 552.66, 410.66 and 782.0 g in winter season was recorded. The average daily weight gain (F1 to F5) of 436.66, 237.33, 422.00, 330.66 and 628.66 g in male calves during winter and average daily weight gain (F1 to F6) of 360, 440, 716.66, 314.66, 475.33 and 558.0 g during winter-spring was recorded. It was concluded that the overall mean of calf birth weight was 35.45 kg. The mean birth weight of buffalo calves was 35.00 kg for females and 35.92 kg for males. The birth weight of male calves was higher than the birth weight of female calves. The average body weight gain per animal was higher during spring months as compared to winter months.

Keywords: Growth performance, Nili Ravi buffalo calf, Birth weight, Spring season, Winter season.

1. Introduction

India's livestock sector is one of the largest in the world comprising 56.7% of world's buffaloes, 12.5% cattle, 20.4% small ruminants, 2.4% camel, 1.4% equine, 1.5% pigs and 3.1% poultry population (DADF, 2012). India contributes 16-17% of world's milk that comes from its 304 million bovine populations (DADF, 2012). Some studies have documented effects of climate change and adaptation on livestock systems in several agricultural regions (Nardone *et al*., 2010; Thornton and Herrero, 2014; Weindl *et al*., 2015; Rojas-Downing *et al*., 2017). However, compared with crops, there has been little research on the potential impacts of climate change on livestock (Porter *et al*., 2014). More so, research on livestock in Asia in general is often neglected in agricultural research (Thornton *et al*., 2009; Musemwa *et al*., 2012). Buffaloes are mostly concentrated in South East Asian countries with most elite dairy breeds like Murrah and Nili Ravi found in India. The productivity of Murrah buffalo undergoes seasonal changes and it has been established that the productivity is affected both directly and indirectly by climatic extremes (West, 2003). Wolfenson and Roth (2019) describe how hot summer conditions disrupt several reproductive processes, resulting in a pronounced depression of conception rate in dairy animals worldwide. When body temperature reaches 40°C a strong impairment of reproductive processes such as disruption of oocyte developmental competence, attenuated embryonic growth and early embryonic death due to impairment of hormone secretion, alteration of ovarian follicular growth dynamics, suboptimal development of the corpus luteum, and attenuated uterine endometrial responses may occur. The few studies on water buffalo have dealt with impacts and adaptation to climate change related heat stress on breeding and health (Yadav *et al*., 2016), physiological functions (Bernabucci *et al*., 2010) and milk production (Upadhyay *et al*., 2010; Kumar *et al*., 2015). Understanding perceptions can be useful in conjunction with scientific knowledge systems and communicating environmental and climate change related policies (Arunrat *et al*., 2017; Burnham and Ma, 2017). Furthermore, climate risk perceptions can serve as predictors of future adaptation strategies and options (Mercado, 2016; Mase *et al*., 2017). The effects of climate change on the health of farm animals have not been studied in depth. However, it can be assumed that as in the case of humans, climate change, in particular global warming, is likely to greatly affect the health of farm animals, both directly and indirectly. Direct

effects include temperature-related illness and death, and the morbidity of animals during extreme weather events. Indirect impacts follow more intricate pathways and include those deriving from the attempt of animals to adapt to thermal environment or from the influence of climate on microbial populations, distribution of vector-borne diseases, host resistance to infectious agents, feed and water shortages, or food-borne diseases. The objective of the present investigation was to study the effect of winter and spring seasons on growth performance of male and female Nili Ravi buffalo calves.

2. Materials and Methods

The Nili-Ravi is one of the important buffalo breeds of India with its home tract in Gurdaspur, Amritsar and Ferozepur districts of Punjab i.e. along with the international border of Pakistan. Due to the non-availability of pure and superior breeding bulls in the tract, farmers face constraint in breeding their Buffaloes. To preserve the important germplasm of Nili-Ravi buffalo in India, Sub-campus of Central Institute for Research on Buffaloes was established on 1st December, 1987 at Bir Dosanjh, Nabha in Punjab by acquiring land and other facilities from the Government of Punjab for research on improvement of Nili-Ravi buffalo. The CIRB, sub campus, Nabha was identified as one of the centers for research work under the Network Programme on buffaloes for Nili-Ravi breed. As the only organized farm of Nili-Ravi breed in India, Central Institute for Research on Buffaloes, sub-Campus, Nabha is contributing to conservation and improvement of this fine breed of buffalo. The date of calving/date of birth, sex of the calf, calf no., birth weight of the calf, initial age of the calf in days from which the fortnightly body weight (F0) was started and after that the fortnightly body weight (F1, F2, F3, F4, F5 and F6) was recorded. The calf morbidity and mortality was recorded as and when occurred. The sick animals were treated by an experienced veterinarian employed at ICAR-CIRB, Sub campus, Nabha and the history of sick and dead calves during the experimental period and the treatment given to them was recorded. Standard concentrate mixture containing 20% crude protein and 70% TDN was prepared from available feed ingredients and was used during the study period as the concentrate supplement for the buffalo herd across the Institute. The experimental animals were fed as per the nutrient requirements of buffaloes (Paul and Lal, 2010). To speed up the development of rumen and early initiation of microbial fermentation, the calves were offered calf starter and green grass from second week of life itself. The whole milk was provided to the calf @ 2.5, 2.5, 3.0, 3.50, 3.50, 3.00, 3.00, 2.00, 1.50, 1.50, 1.00, 0.50, 0.00 kg during 1st to 13th week of age; and the calf starter was given to the calf @ 0.00, 0.05, 0.10, 0.20, 0.40, 0.60, 0.70, 0.80, 1.00, 1.20, 1.30, 1.40 and 1.70 kg during 1st to 13th week of age, respectively. Total quantity of daily milk offered to calves was divided into two equal volumes and offered twice daily at 05.00 and 17.00 h. The calf starter contained 22% Crude Protein and 70-75% Total Digestible Nutrients and was formulated based on the locally available feed resources. All animals were fed in groups throughout the experimental period. Fresh water was made available to every dam round the clock and all the animals had free access to a daily supply of palatable drinking water sufficient for their needs. Troughs were cleaned and maintained regularly. The quality of water was monitored regularly as water needs, if not adequately fulfilled, can lead to rapid deterioration of animal health and welfare. With regard to temperature of drinking water, the temperature of drinking water has only a slight effect on drinking behavior and animal performance. All possible efforts were made to provide fresh drinking water to the animals. As far as a choice of water temperature is concerned, the dairy animals prefer to drink water with moderate temperatures (17-28°C) rather than cold or hot water (Andersson, 1987; Lanham *et al*., 1986; Wilks *et al*., 1990). For the purpose of studying the effect of season on growth performance of Nili Ravi male and female calves the whole year was divided into four seasons namely, winter (November to January), spring (February to April), summer (May to July) and autumn (August to October). However, the only data for the winter and spring seasons was available. Calves were weighed fortnightly before the morning feeding to monitor their growth performance.

3. Results and Discussion

3.1 Spring Season

The data pertaining to female calf birth weight, date of birth, sex, calf No., initial age in days on 25.01.2016 i.e. from the start of fortnightly body weight (F0) and subsequently fortnightly body weights (F1 to F6) during spring season is given in Table 1.

3.1.1 Female Calves

Sixteen female calves were born between 01.11.2015 to 21.01.2016, having a total body weight of 574.8 Kg with an average body weight of 35.92 Kg per animal. The average initial age on dated 25.01.2016 was 44.56 days. The total body weight of 16 calves on dated 25.01.2016 was 873.5 Kg with an average body weight of 54.59 Kg. The date of 25.01.2016 was taken as the starting date for the weighing of fortnightly body weight (F1 to F6). The total body weight (Kg) in F1 to F6, was 1057.5, 1125, 1209.6, 1331, 1390 and 1464.15 kg, with an average body weight (kg) of 66.09, 70.3, 75.60, 83.18, 86.87 and 91.50. The total fortnightly body weight gain (Kg) in F1 to F6 was 11.5, 4.22, 5.29, 7.58, 3.69 and 4.63 (Kg), with an average daily weight gain of 766.66, 281.33, 352.66, 505.33, 246.0 and 308.68 g. The average daily weight gain varied between 246.0 to 766.66 g. In the present study, large variations in the average daily weight gain per day were reported

Table 1: Spring effect on growth performance of Nili Ravi female calves

S. No	Calf No.	Sex	DOB	Birth Wt (Kg)	Initial age (D) on 25.01.16	Initial B. Wt.	Fort nightly body weight					
						F0: 25.1.16	F1: 10.2.16	F2: 25.2.16	F3 12.3.16	F4 28.3.16	F5 13.4.16	F6 30.4.16
1	558	F	01.11.15	42	85	72	74.3	82	90.15	95	96	102.5
2	559	F	05.11.15	26	80	58	62	68	79	88	94	95.1
3	560	F	09.11.15	25	76	52	60	62	64.4	71	75.1	76.5
4	563	F	19.11.15	39	66	68	77	82	84.75	88	101.4	104.2
5	564	F	21.11.15	38	64	65	81	83	90	101	102	107.3
6	565	F	29.11.15	30	56	61	88	92	87	95	101	108.7
7	567	F	30.11.15	37	55	59	80	81	91.3	94	107	94.3
8	568	F	09.12.15	34	46	54	78	79	80	88	91	101.4
9	569	F	12.12.15	33.3	43	54	58.6	63	69	97	77.9	81.2
10	570	F	25-12-15	36.5	30	46	53	58	62	68	73.6	84.3
11	571	F	26.12.15	42.5	29	58	68	74	79	86	88.2	96.55
12	572	F	29.12.15	39	26	51	64	68	73	80	85	91.15
13	573	F	29.12.15	37	26	44	52	61	70	73	79.8	87.5
14	574	F	02.01.16	37.5	23	52	61	62	69	78	81.75	84.8
15	576	F	21.01.16	38	4	41	51.6	55	60	64	70	79
16	577	F	21.01.16	40	4	38.5	49	55	61	65	66.25	69.65
Total Body Weight (Kg)				574.8	713	873.5	1057.5	1125	1209.6	1331	1390	1464.15
Average Body Weight (Kg)				35.92	44.56	54.59	66.09	70.31	75.60	83.18	86.87	91.50
Total Fortnightly B Wt Gain (Kg)							11.5	4.22	5.29	7.58	3.69	4.63
Average BWG/d g							766.66	281.33	352.66	505.33	246.00	308.66

which could be due to large difference in the age of individual animal, taken as average initial age on 25.01.2016. The study further observed that the animals were offered concentrate feed in group which might have led to the uneven feeding of the animals resulting in reduced nutrient intake of the animals. Similarly, calves provided access to higher volumes of milk early in life can double their nutrient intake compared with those fed amounts equivalent to approximately 10% of BW, and these calves are able to gain more weight compared with restricted-fed counterparts. Higher milk intakes also result in improved feed conversion efficiencies during the preweaning period (Diaz *et al*., 2001; Khan *et al*., 2007), as young animals preferentially make use of available nutrients to maintain vital body functions and only those nutrients in excess of what is required for maintenance can be used for tissue gain and skeletal growth (NRC, 2001). Conventional feeding practices (i.e., limiting milk intake) leave calves hungry and compromise growth, health, welfare, and future milk production.

3.2 Winter Season

The data pertaining to female calf birth weight, date of birth, calf No., initial age in days on 02.11.2015 i.e. from the start of fortnightly body weight (F0) and subsequently fortnightly body weights (F1 to F5) during winter season is given in Table 2.

3.2.1 Female Calves

Twenty four female calves were born between 22.07.2015 to 26.10.2015, with a total body weight of 825.4 Kg and an average body weight of 34.39 Kg per animal. The average initial age on dated 02.11.2015 was 52.33 days. The total body weight of 24 female calves on dated 02.11.2015 was 1199.1 Kg with an average body weight of 49.96 Kg per animal. The date of 02.11.2015 was taken as the starting date for the weighing of fortnightly body weights (F1 to F5). The total body weight (Kg) in F1 to F5, was 1341.2, 1384.9, 1644, 1792 and 2073.5, with an average body weight (kg) of 55.88, 60.21, 68.50, 74.66, and 86.39. The total

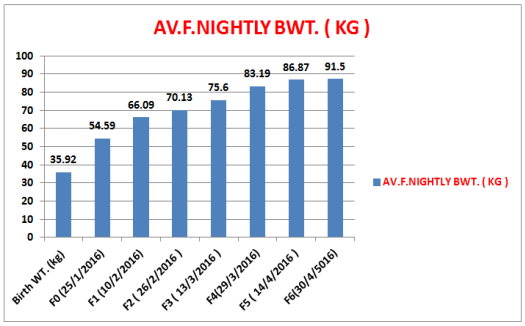

Fig 1: Clustered Column Diagram.

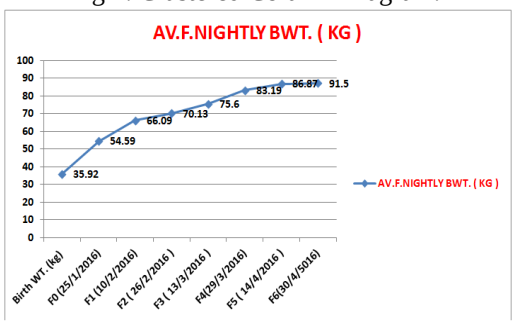

Fig 2: Marker Line Diagram.

Table 2: Winter effect on growth performance of Nili Ravi female calves

S.No	Calf No.	Sex	DOB	Birth Wt (Kg)	Initial age (D) on 2.11.15	Initial B. Wt.	Fort nightly body weight				
						F0: 2.11.15	F1: 18.11.15	F2: 4.12.15	F3 20.12.15	F4 5.1.16	F5 21.1.16
1	531	F	22.07.15	39	99	67	75.5	80	100	104	120
2	532	F	23.07.15	35.4	98	65	71.2	72	83	95	105
3	533	F	28.07.15	35.2	93	64.2	67.2	74.05	80	87	96
4	534	F	02.08.15	35	90	73.4	81	83	86	96	113
5	535	F	15.08.15	38	77	54.75	56	68.2	73	80	88
6	536	F	16.08.15	28	76	56	63.5	66	76	84	97
7	539	F	23.08.15	17.5	69	41	50	51.15	55	61	74
8	540	F	29.08.15	41	63	58.7	65.1	66	83	92	106
9	541	F	31.08.15	31	62	47.6	51.3	52.9	64	66	73
10	542	F	03.09.15	37.5	59	46.75	54.6	58	63	71	82
11	543	F	06.09.15	29.8	56	53.3	60.2	69.8	72	75	83
12	545	F	12.09.15	37.5	50	50.7	53.5	55.75	63	68	75
13	546	F	13.09.15	38	49	51.6	57.8	63	75	83	95
14	547	F	13.09.15	39.1	49	47.5	55.2	56.55	60	68	81
15	548	F	18.09.15	31.6	43	44.85	50.6	55.5	66	67	85
16	549	F	23.09.15	27	39	35.55	41	51.6	53	55	70
17	550	F	24.09.15	34	38	45.25	53.1	58.25	66	68	70
18	551	F	26.09.15	35.3	36	51	58.2	60.21	71	83	94
19	552	F	28.09.15	33	34	39.5	42	49.35	55	63	72
20	553	F	05.10.15	37	27	45	48.3	57.7	63	68	82
21	554	F	12.10.15	39	20	44.25	53	55	67	77	93
22	555	F	20.10.15	37.4	12	41.3	47.2	50.1	64	68	81.5
23	556	F	21.10.15	32	11	34.9	37	42	46	51	61
24	557	F	26.10.15	37.1	6	40	48.7	49	60	62	77
Total Body Weight (Kg)				825.4	1256	1199.1	1341.2	1384.9	1644	1792	2073.5
Average Body Weight (Kg)				34.39	52.33	49.96	55.88	60.21	68.50	74.66	86.39
Total Fortnightly B Wt Gain (Kg)							5.92	4.33	8.29	6.16	11.73
Average BWG/d g							394.66	288.66	552.66	410.66	782.00

fortnightly body weight gain in F1 to F5 was 5.92, 4.33, 8.29, 6.16 and 11.73 (Kg), with an average daily weight gain of 394.66, 288.66, 552.66, 410.66 and 782.0 g, respectively. The average daily weight gain varied between 288.66 to 782.0 g.

3.3 Winter Season

The data pertaining to male calf birth weight, date of birth, calf No., initial age in days on 02.11.2015 i.e. from the start of fortnightly body weight (F0) and subsequently fortnightly body weights (F1 to F5) during winter season is given in Table 3.

3.3.1 Male Calves

During 22.07.15 to 29.09.2015, twenty two male calves were born, with a total body weight of 811.1 Kg and an average body weight of 36.86 Kg per animal. The average initial age on dated 02.11.2015 was 65.22 days.

The total body weight of 22 male calves on dated 02.11.2015 was 1205.1 Kg with an average body weight of 57.38 Kg per animal.

The date of 02.11.2015 was taken as the starting date for the weighing of fortnightly body weights (F1 to F5). The total body weight (Kg) in F1 to F5, was 1406.3, 1417.25, 1624, 1733 and 1940.4, with an average body weight (kg) of 63.92, 67.48, 73.81, 78.77 and 88.2.

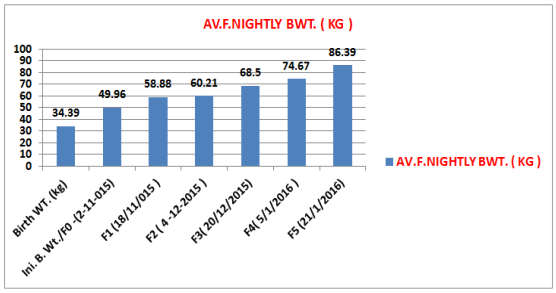

Fig 3: Clustered Column Diagram.

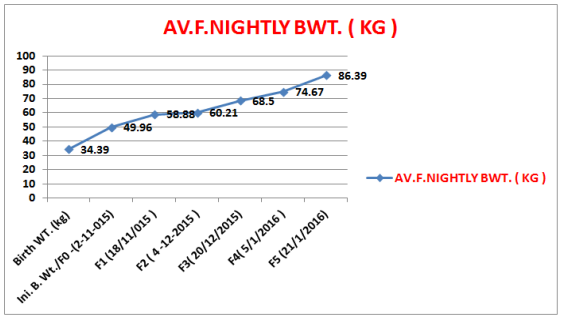

Fig 4: Marker Line Diagram.

The total fortnightly body weight gain in F1 to F5 was 6.55, 3.56, 6.33, 4.96 and 9.43 (Kg), with an average daily weight gain of 436.66, 237.33, 422.00, 330.66 and 628.66 g. The average daily weight gain varied between 237.33 to 628.66 g.

Table 3: Winter effect on growth performance of Nili Ravi Male calves

S.No	Calf No.	Sex	DOB	Birth Wt (Kg)	Initial age (D) on 2.11.15	Initial B. Wt.	Fort nightly body weight				
						F0: 2.11.15	F1: 18.11.15	F2: 4.12.15	F3 20.12.15	F4 5.1.16	F5 21.1.16
1	551	M	22.07.15	40.5	100	76	85	87.75	89	99	107
2	552	M	25.07.15	48.6	97	72.2	81	86	87	99	108
3	553	M	28.07.15	31	94	63	68.2	73.2	68	72	91
4	554	M	29.07.15	47.1	93	76.5	82	85.3	100	103	115
5	555	M	07.08.15	45.3	85	58.7	64.2	66.55	71	74	81
6	556	M	10.08.15	34	82	58	66	67.4	70	75	84
7	557	M	15.08.15	42.5	77	63.2	68.2	70	73	83	90
8	558	M	17.08.15	38.5	75	58	61.2	67.48	76	71	90
9	559	M	20.08.15	38	72	63.2	70.6	75	85	86	106
10	561	M	25.08.15	38.7	67	63.8	69.6	71	80	83	97
11	562	M	31.08.15	36.2	61	64	74.3	79.1	80	86	92
12	563	M	01.09.15	31.8	60	47	54	56	62	65	76
13	564	M	02.09.15	36.2	60	57.38	59	62	70	75	86
14	565	M	02.09.15	37.6	60	61.3	71	74	80	83	84.4
15	566	M	08.09.15	32.2	53	45	57.4	62.75	73	76	85
16	567	M	10.09.15	36	51	47	49	54	63	71	78
17	568	M	10.09.15	33	51	54.75	60.5	62	75	78	95
18	569	M	12.09.15	36	49	46.5	55.2	56	58	60	62
19	570	M	16.09.15	36	45	53	62.3	63.7	82	88	104
20	571	M	23.09.15	29	38	41.3	47.8	50.3	54	68	55
21	573	M	28.09.15	32.5	33	49.75	54.8	59.2	71	78	92
22	574	M	29.09.15	30.4	32	42.9	45	56	57	60	62
Total Body Weight (Kg)				811.1	1435	1205.1	1406.3	1417.25	1624	1733	1940.4
Average Body Weight (Kg)				36.86	65.22	57.38	63.92	67.48	73.81	78.77	88.2
Total Fortnightly B Wt Gain (Kg)							6.55	3.56	6.33	4.96	9.43
Average BWG/d g							436.66	237.33	422.00	330.66	628.66

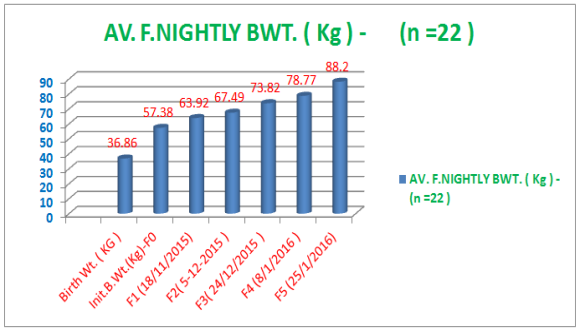

Fig 5: Two Dimensional Cylindrical Clustered Column Diagram.

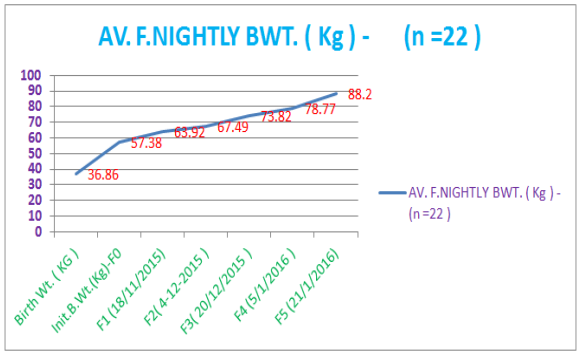

Fig 6: Line Diagram.

3.4 Winter-Spring Season

The data pertaining to male calf birth weight, date of birth, calf No., initial age in days on 02.11.2015 i.e. from the start of fortnightly body weight (F0) and subsequently fortnightly body weights (F1 to F6) during winter-spring season is given in Table 4.

3.4.1 Male Calves

Fifteen male calves were born during 05.10.2015 to 02.12.2015, having a total body weight of 518.1 Kg with an average body weight of 34.54 Kg per animal. The average initial age on dated 24.12.2015 was 45.66 days. The total body weight of 16 calves on dated 24.12.2015 was 805 Kg with an average body weight of 53.66 Kg. The date of 24.12.2015 was taken as the starting date for the weighing of fortnightly body weight (F1 to F6). The total body weight (Kg) in F1 to F6, was 886, 985, 1146.2, 1217, 1323.45 and 1449 kg, with an average body weight (kg) of 59.06, 65.66, 76.41, 81.13, 88.23 and 96.6. The total fortnightly body weight gain (Kg) in F1 to F6 was 5.4, 6.6, 10.75, 4.72, 7.13 and 8.37 (Kg), with an average daily weight gain of 360, 440, 716.66, 314.66, 475.33 and 558.0 g. The average daily weight gain varied between 314.66 to 716.66 g. Calf birth weight is one of the important factors in a successful animal breeding program due to

Table 4: Winter and spring effect on growth performance of Nili Ravi Male calves

S.No	Calf No.	Sex	DOB	Birth Wt (Kg)	Initial age (D) on 24.12.15	Initial B. Wt.	Fort nightly body weight					
						F0: 24.12.15	F1: 9.1.16	F2: 25.1.16	F3 10.2.16	F4 26.2.16	F5 14.3.16	F6 30.3.16
1	575	M	05.10.15	32	79	69	74	83	99	107	114	128
2	576	M	08.10.15	36	76	71	81	91	103	107	115	129
3	578	M	23.10.15	32.7	61	55	58	64	76	83	90	104
4	579	M	26.10.15	32.4	58	53	62	67	74.2	76	85	96
5	580	M	27.10.15	31.5	57	42	48	58	62	67	68.3	70
6	581	M	01.11.15	32	53	61	65	60	88	93	97.5	107
7	582	M	03.11.15	40.5	51	56	58	72	84	90	97	105
8	583	M	07.11.15	39	47	56	63	70	81	88	100	108
9	584	M	19.11.15	35	35	46	51	61	78	70	81	84
10	585	M	19.11.15	29	35	46	49	59	60	65	74.7	78
11	586	M	20.11.15	34	34	53	60	70	83	93	103	116
12	587	M	24.11.15	49	30	54	58	60	62	65	67	72
13	588	M	30.11.15	35	24	50	52	48	56	63	66.65	70
14	589	M	01.12.15	28	23	49	57	66	75	78	86.7	93
15	590	M	02.12.15	32	22	44	50	56	65	72	77.6	89
Total Body Weight (Kg)				518.1	685	805	886	985	1146.2	1217	1323.45	1449
Average Body Weight (Kg)				34.54	45.66	53.66	59.06	65.66	76.41	81.13	88.23	96.6
Total Fortnightly B Wt Gain (Kg)							5.4	6.60	10.75	4.72	7.13	8.37
Average BWG/d g							360	440	716.66	314.66	475.33	558.0

its strong influence on survival rate and growth performance. In the present study, the overall mean of calf birth weight was 35.45 kg. The mean birth weight of buffalo calves was 35.00 kg for females and 35.92 kg for males. Therefore, the birth weight of male calves was higher than the birth weight of female calves. This result was in agreement with those of earlier reports (Legaulth and Touchberry, 1962; Ahunu *et al*., 1997; Bayram *et al*., 2000; Jain *et al*., 2000; Kocak *et al*., 2007; Lateef, 2007; Orenga *et al*., 2009; Akdag *et al*., 2011; Reynolds *et al*., 1980). In the present study, the average daily body weight gain (BWG) of female calves in spring season was 410.1 g and during winter, the average daily BWG of female calves was 404.77 g. The average daily BWG of female calves was higher during spring as compared to winter season. In the case of male calves, the average daily BWG was 342.55 g during winter months. The average daily BWG of female calves was 477.44 g during winter-spring months.

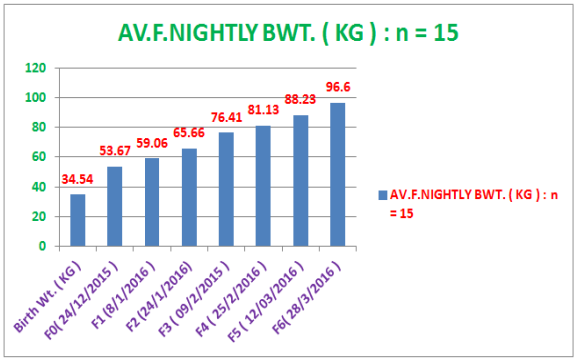

Fig 7: Two Dimensional Clustered Column Diagram.

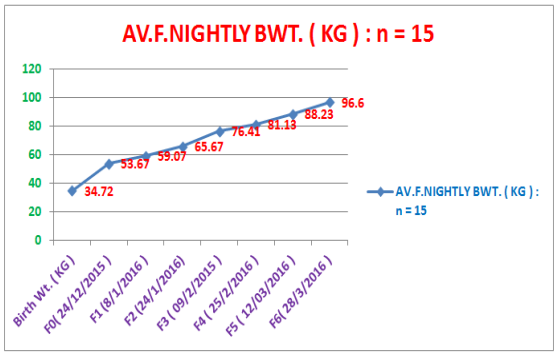

Fig 8: Marker Line Diagram.

Fig 9: A view of calf shed at CIRB, Nabha, showing small animals are unable to eat.

The overall average daily BWG of female calves was 407.43 g and those of male calves was 409.99 g, with an overall daily average BWG of 408.71 g in male and female calves. In the present study, the overall average daily BWG of 408.71 g in male and female calves was reported. This result was in agreement with

that of Rashid *et al*. (2013); Abbas *et al*. (2017) who also reported that buffalo calves weaned at the 8th, 10th and 12th week displayed similar growth rates (387-401 g/day) up to the age of 12 weeks. However, the overall average daily BWG reported in the present study was lower than earlier reports. Azim *et al*. (2011) has reported an average growth rate of 520 g/day in buffalo calves weaned at day 45 and offered early weaning diets. Abdullah *et al*. (2013) also reported that the average daily gain of buffalo calves fed whole milk at 10% of body weight up to day 56 and weaned at 120 days was 457 g/day.

4. Conclusion

It was concluded that the overall mean of calf birth weight was 35.45 kg. The mean birth weight of buffalo calves was 35.00 kg for females and 35.92 kg for males. The birth weight of male calves was higher than the birth weight of female calves. The average body weight gain per animal was higher during spring months as compared to winter months.

References

Abbas W, Bhatti SA, Khan MS, Saeed N, Hassan M Warriach HM, Wynn P and McGill D (2017). Effect of weaning age and milk feeding volume on growth performance of Nili-Ravi buffalo calves. *Italian Journal of Animal Science*, 16(3): 490-499.

Abdullah M, Iqbal ZM, Saadullah M, Haq A, Javed K, Jabbar MA and Tauseef A (2013). Comparative performance of calves fed milk and/or milk replacer supplemented with calf starter up to weaning age in Nili-Ravi buffaloes. *Buffalo Bull*, 32: 874-877.

Ahunu BK, Arthur PF and Kissiedu HWA (1997). Genetic and phenotypic parameters for birth weight and weaning weights of purebred and crossbred N'Dama and West African Shorthorn Cattle. *Livestock Production Science*, 51: 165-171.

Akdağ F, Arslan S, Caynak A and Teke B (2011). The relationships phenotype, genotype and some environmental factors with weight in Jersey calves. *African Journal of Biotechnology*, 10: 7308-7313.

Andersson M (1987). Effects of number and location of water bowls and social rank on drinking behaviour and performance of loose-housed dairy cows. *Livestock Production Science*, 17: 19-31.

Arunrat N, Wang C, Pumijumnong N, Sereenonchai S and Cai W (2017). Farmers' intention and decision to adapt to climate change: a case study in the Yom and Nan basins, Phichit province of Thailand. *Journal of Cleaner Production*, 143: 672-685.

Azim A, Khan AG, Anjum MI and Nadeem MA (2011). Effect of milk replacer and early weaning diets on growth performance of buffalo calves during weaning period. *Pakistan Veterinary Journal*, 31: 23-26.

Bayram B, Guler O, Yanar M, Akbulut O, Aydin R, Bilgin OC and Tuzemen N (2008). Inbreeding levels with some of its effects on the reproductive performance and milk yields in holstein cattle raised in Ataturk university faculty of agriculture, farm grown black pied cattle breeding and milk yield. *Journal of Animal Production*, 49(2): 1-6.

Bernabucci U, Lacetera N, Baumgard LH, Rhoads RP, Ronchi B and Nardone A (2010). Metabolic and hormonal acclimation to heat stress in domesticated ruminants. *Animal*, 4(7): 1167-1183.

Burnham M and Ma Z (2017). Climate change adaptation: factors influencing Chinese smallholder farmers' perceived self-efficacy and adaptation intent. *Regional Environmental Change*, 17(1): 171-186.

DADF (2012). Department of animal husbandry, dairying and fisheries. 19th Livestock Census All India Report. Vol. I. New Delhi: Government of India.

Diaz MC, Van Amburgh ME, Smith JM, Kelsey JM and Hutten EL (2001). Composition of growth of Holstein calves fed milk replacer from birth to 105-kilogram body weight. *Journal of Dairy Science*, 84: 830-842.

Jain JK, Khan FH, Ashog S and Sing A (2000). Birth weight and growth parameters in Jersey. *Indian Journal of Dairy Science*, 53(3): 205-209.

Khan MA, Lee HJ, Lee WS, Kim HS, Kim SB, Ki KS, Ha JK, Lee HG and Choi YJ (2007). Pre- and postweaning performance of Holstein female calves fed milk through step-down and conventional methods. *Journal of Dairy Science*, 90: 876-885.

Kocak S, Tekerli M, Ozbeyaz C and Yuceer B (2007). Environmental and genetic effects on birth weight and survival rate in holstein calves. *Turkish Journal of Veterinary and Animal Sciences*, 31(4): 241-246.

Kumar S, Raju B, Ramarao C and Ramilan T (2015). Sensitivity of livestock production to climatic variability under Indian drylands and future perspective. *Current Agriculture Research Journal*, 3(2): 142.

Lanham JK, Coppock CE, Milam KZ, Labore JM, Nave DH, Stermer RA and Brasington CF (1986). Effects of drinking water temperature on physiological responses of lactating Holstein cows in summer. *Journal of Dairy Science*, 69: 1004-1012.

Lateef M (2007). Production performance of Holstein Friesian and Jersey cattle in sub tropical environment of the Punjab, Pakistan. Ph.D. Thesis. Department of Livestock Management University of Agriculture Faisalabad. Pakistan.

Legaulth CR and Touchberry RW (1962). Heritability of birth weight and its relationship with production in dairy cattle. *Journal of Dairy Science*, 45(10): 1226-1233.

Mase AS, Gramig BM and Prokopy LS (2017). Climate change beliefs, risk perceptions, and adaptation behavior among Midwestern U.S. crop farmers. *Climate Risk Management*, 15: 8-17.

Mercado RM (2016). People's risk perceptions and responses to climate change and natural disasters in BASECO compound, Manila, Philippines. *Proceedings Environment Science*, 34(Supplement C): 490-505.

Musemwa L, Muchenje V, Mushunje A and Zhou L (2012). The impact of climate change on livestock production amongst the resource-poor farmers of third world countries: a review. *Asian Journal of Agriculture and Rural Development*, 2(4): 621-631.

Nardone A, Ronchi B, Lacetera N, Ranieri MS and Bernabucci U (2010). Effects of climate changes on animal production and sustainability of livestock systems. *Livestock Science*, 130(1-3): 57-69.

NRC (2001). National Research Council. Nutrient Requirements of Dairy Cattle: Seventh Revised Edition, Washington, DC: The National Academies Press. https://doi.org/10.17226/9825.

Orenga JSK, Ilatsia ED, Kosgey IS and Kahi AK (2009). Genetic and phenotypic parameters and annual trends for growth and fertility trait of charolais and Hereford beef cattle breeds in Kenya. *Tropical Animal Health and Production*, 41: 767-774.

Paul SS and Lal D (2010). Nutrient requirements of buffaloes. ICAR-Central Institute for Research on Buffaloes. Satish Serial Publishing House, 403, Express Tower, Commercial Complex, Azadpur, Delhi-110033 (India). ISBN: 81-89304-76-3.

Porter JR, Xie L, Challinor AJ, Cochrane K, Howden SM and Iqbal MM (2014). Food security and food production systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Inter governmental Panel on Climate Chan. *Cambridge University Press*. pp. 485-533.

Rashid MA, Pasha TN, Jabbar MA, Ijaz A, Rehman H and Yousaf MS (2013). Influence of weaning regimen on intake, growth characteristics and plasma blood metabolites in male buffalo calves. *Animal*, 7: 1472-1478.

Reynolds WL, De Rounen TM, Moin S and Koonce KL (1980). Factors influencing Agestation length, birth weight and calf survival of Angus, Zebu and Zebu cross beef cattle. *Journal of Animal Science*, 51: 860-867.

Rojas-Downing MM, Nejadhashemi AP, Harrigan T and Woznicki SA (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, http://dx.doi.org/10.1016/j.crm.2017.02.001.

Thornton PK and Herrero M (2014). Climate change adaptation in mixed crop-livestock systems in developing countries. *Global Food Security*, 3(2): 99-107.

Thornton PK, Van de Steeg J, Notenbaert A and Herrero M (2009). The impacts of climate change on livestock and livestock systems in developing countries: a review of what we know and what we need to know. *Agricultural Systems*, 101(3): 113-127.

Upadhyay RC, Ashutosh A, Gupta SK, Kumar A and Singh SV (2010). Impact of climate change on milk production of Murrah buffalo. *Italian Journal of Animal Science*, 6(2s): 1329-1332.

Weindl I, Lotze-Campen H, Popp A, Müller C, Havlík P and Herrero M (2015). Livestock in a changing climate: Production system transitions as an adaptation strategy for agriculture. *Environmental Research Letters*, 10(9).

West JW (2003). Effects of heat-stress on production in dairy cattle. *Journal of Dairy Science*, 86: 2131-2144.

Wilks DL, Coppock CE, Lanham JK, Brooks KN, Baker CC, Bryson WL, Elmore RG and Stermer RA (1990). Responses of lactating Holstein cows to chilled drinking water in high ambient temperatures. *Journal of Dairy Science*, 73: 1091-1099.

Wolfenson D and Roth Z (2019). Impact of heat stress on cow reproduction and fertility. *Animal Frontiers*, 9(1): 32-38.

Yadav B, Pandey V, Yadav S, Singh Y, Kumar V and Sirohi R (2016). Effect of misting and wallowing cooling systems on milk yield, blood and physiological variables during heat stress in lactating Murrah buffalo. *Journal of Animal Science and Technology*, 58: 2.