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# Effect of Different Feed Combinations on the Growth Performance of Cross-Bred Heifer Calves

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## ABSTRACT

This study was conducted to evaluate the growth performance and feed intake of crossbred (Holstein Friesian×Sahiwal) and (Jersey×Sahiwal) heifer calves fed different feed combinations of concentrate mixture using 24 heifer calves with average initial weight of 55.27±2.53[a], 57.30±1.82[a], 60.26±1.40[a] and 62.00[a] kg at 4 months of age. The calves were assigned into treatments having, $T_1$ = Control (Farm ration), $T_2$ = 50% Barley+30% MC+0% AC+8% WB 2% MM, T3 = 50% Maize+30% MC+10% AC+8% WB 2% MM, $T_4$ = 50% Sorghum+30% MC+10% AC+8% WB 2% MM, using randomized complete block design into four blocks of six animals. The total DM and DMI (% of body weight) intake for $T_3$ and $T_2$ diets were higher ($p<0.05$) than those fed $T_1$ and T4 diets. The overall Average Daily Gain (ADG) was higher (0.55 kg day$^{-1}$) in $T_3$ than of $T_2$ and $T_4$, whereas ADG found to be lowest in $T_1$ (0.40 kg day$^{-1}$). The body measurements (Heart girth, length and height) were also higher in $T_3$ compared to those fed $T_1$, $T_2$ and $T_4$ diets ($p<0.05$). It is calculated that 50% Maize+30% MC+10% AC+8% WB 2% MM, enhanced growth parameters, feed utilization and reproductive performance of cross-bred heifer calves in terms of age at puberty was achieved higher.

**Key words:** Feed combination, weight gain, body measurements, puberty, cross-bred heifer

## INTRODUCTION

Replacement heifers are a vital component of the cow-calf sector. These animals represent the introduction of new genetics and contribute to the future productivity of the herd. Dairy heifer replacement breeding is an important area in any dairy farm enterprise, but it is often neglected as other more pressing issues take priority on the farm. This means that dairy heifers do not grow at the required rate to hit the expected targets at bulling and calving. The end result is that heifers calve in too old and without the required development to ensure they have long and productive lives in the herd. Poor growth rate resulting in delayed age at maturity in our local dairy animals further aggravates the situation. However, cost of heifer production can be reduced through better management, balanced feeding, use of performance modifiers and better health care (Bhatti *et al*., 2007). With a little effort, by producing a heifer rearing plan, then monitoring growth performance against set targets and taking corrective measures where necessary, this can reduce the cost of heifer development, this doesn't has to be rocket science to achieve but it will have dramatic effects on the future profitability of the enterprise. Heifer production is most expensive part of the dairy farm operation (Heinrichs, 1993). It requires more inputs for a longer period of

time with no visible returns than any other farm operation. Growth rates of replacement heifers affect economic returns on dairy farms (Cady and Smith, 1996). Balanced feeding, improved management and minimum disease prevalence can be helpful in reducing the age at first calving (Heinrichs *et al*., 2005). Proteins and energy are most critical nutrients influencing the growth of calves to become heifers. However, minerals and vitamins are also important. Other than essential nutrients, there are performances modifiers that can accelerate the growth rate of claves and help attain early puberty in heifers. Age at puberty and calving is related with weight (Moore *et al*., 1990). Nutrition plays a major role in attaining the proper weight at proper time (Chaudhry *et al*., 1988; Marston *et al*., 1995).

Nutrient requirements recommended by NRC (2001) are widely adopted to formulate diet for ruminant animals around the world but these were based on *Bos taurus*. The question arise for optimum nutrients requirements of cross-bred heifers. Scientific literature regarding the influence of different level of feeds on performance of cross-bred heifers in tropical and subtropical countries is very limited. The current study was designed to evaluate performance of cross-bred heifer calves fed different feed combinations during pubertal period under sub tropical environmental condition of India, which might make a significant addition to existing knowledge. The specific objectives of current study were to determine the impact of feed combinations on growth and age at puberty in cross-bred heifers.

## MATERIALS AND METHODS

Twenty four Holstein×Sahiwal (HS) and Jersy×Sahiwal (JS) healthy female calves of an age of 4-5 months of age were selected and divided into four groups (six in each group) i.e., $T_1$ (farm ration), $T_2$, $T_3$ and $T_4$, (self prepared) respectively and allotted to each of four feeding regimes in four treatment groups. Care was taken that in all groups, the experimental calves were similar in respect to size, health, body weight and age. Before the start of experiment all the animal were deworming against internal and external parasite. Ingredient and nutrient composition is mentioned in Table 1 and 2.

**Housing and feeding:** All the experimental animals were housed in a well ventilated and spaciously portioned with cement wall to facilitate the individual feeding and watering. Healthy surroundings and proper sanitation conditions were maintained. The animals of various experimental groups were fed farm and self prepared ration comprising green fodder (MP chari, maize, cow pea and berseem etc. depending on seasonal availability) and wheat straw as the dry roughage along with a balanced concentrate mixture and mineral (1.5 kg concentrate per animal/day from 4-6 months and 2.0 kg from 7-15 months of age) to meet the requisite nutritional requirements. The quantity of diet offered was calculated for each individual animal (dry matter basis).

Table 1: Ingredient for experimental diet

| | Inclusion level (%) | | |
|---|---|---|---|
| Ingredients | $T_2$ | $T_3$ | $T_4$ |
| Maize | - | 50 | - |
| Barley | 50 | - | - |
| Sorghum | - | - | 50 |
| WB | 8 | 8 | 8 |
| AC | 10 | 10 | 10 |
| MC | 30 | 30 | 30 |
| MM | 2 | 2 | 2 |

WB: Wheat bran, AC: Arhar chuni, MC: Mustard cake, MM: Mineral mixture

Table 2: Chemical composition of different ingredient as used in the experiment

| | | Chemical composition DM basis (%) | | | | |
|---|---|---|---|---|---|---|
| Feed ingredient | DM | CP | EE | CF | NFE | Total Ash |
| **Concentrates** | | | | | | |
| AC | 87.65 | 20.81 | 1.80 | 16.03 | 53.11 | 8.25 |
| Barley | 85.21 | 9.02 | 2.81 | 6.80 | 78.66 | 2.71 |
| Maize | 88.90 | 10.45 | 3.25 | 2.01 | 84.30 | 2.00 |
| MC | 78.26 | 36.10 | 10.03 | 8.05 | 39.75 | 6.07 |
| Sorghum | 87.50 | 8.64 | 2.42 | 3.01 | 83.10 | 2.83 |
| WB | 90.00 | 15.08 | 3.06 | 12.10 | 63.01 | 6.75 |
| **Roughages** | | | | | | |
| Berseem | 14.28 | 18.17 | 3.18 | 25.91 | 39.48 | 13.26 |
| MP chari | 19.57 | 11.75 | 1.20 | 33.74 | 42.81 | 10.50 |
| Cow pea | 17.85 | 24.25 | 2.80 | 26.30 | 37.00 | 9.65 |
| Wheat bhusa | 87.50 | 3.20 | 1.50 | 38.40 | 45.76 | 11.50 |

DM: Dry matter, CP: Crude protein, EE: Ether extract, CF: Crude fibre, NFE: Nitrogen free extract, T1: Control (Farm ration), T2: 50% Barley+30% MC+10% AC+8% WB 2% MM, T3: 50% Maize+30% MC+10% AC+8% WB 2% MM, T4: 50% Sorghum+30% MC+10% AC+8% WB 2% MM, AC: Arhar chuni, MC: Mustard cake, WB: Wheat bran

**Data recorded and parameters studied:** Feed intake of each experimental animal was recorded daily. Body weight and body measurements (Heart girth, length and height) were taken monthly. Estrus signs were detected with the help of sexually active teaser bull was started at the age of 12-15 months. The months of appearance of first heat and body weight were recorded. However, overall performance of cross-bred heifers fed varying levels of feed was also observed on dry matter intake (kg day$^{-1}$), dry matter intake (percentage of body weight), average daily gain (g day$^{-1}$) and body (Heart girth, length and height) measurements (cm).

**Laboratory analysis:** All the feed ingredients were ground and filtered in 100 mm sieves and collected for proximate analysis of feeds. The feeds were analyzed for dry matter, crude protein, ether extract, crude fiber, nitrogen-free extract and ash were analyzed according to the method developed by Van Soest and Robertson (1985). These analyses were performed in laboratory of Department of Animal Husbandry and Dairying Lab at Banaras Hindu University, Varanasi, India.

**Statistical analysis:** The data was statistically analyzed using GLM procedure was applied in experiment whenever to test differences. The following model was used:

$$Y = \mu+Ti+P_n+TP_{in}+e_{ins}$$

Where:
Y = Observed trait
$\mu$ = Overall mean
Ti = Effect of ith treatments (ith = $T_1$, $T_2$, $T_3$)
e = Random error
$P_n$ = Effect of nth periods (nth = 0, 30, 60)
$TP_{in}$ = Interaction between $T_i$ and $P_n$

## RESULTS AND DISCUSSION

**Chemical composition of the experimental feeds:** The chemical composition (concentrates and roughage) of the experimental feeds used in the study is presented in Table 2. The DM contents of the ingredients used in the study varied from 14.28% in berseem to 90% in wheat bran. The CP contents of the feeds ranged from 3.20% in wheat straw to 36.10% in mustard cake. The EE values

Table 3: Dry matter intake kg/day (dry matter basis) of cross-bred heifer calves

| | Treatment groups | | | |
|---|---|---|---|---|
| Age (months) | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| 4 | 1.30±0.06$^{a}$ | 1.36±0.05$^{a}$ | 1.50±0.05$^{a}$ | 1.53$^{a}$ |
| 5 | 1.60±0.04$^{b}$ | 1.70±0.02$^{b}$ | 1.83±0.05$^{a}$ | 1.84±0.03$^{a}$ |
| 6 | 1.91±0.04$^{c}$ | 2.04±0.02$^{b}$ | 2.24±0.04$^{a}$ | 2.11±0.06$^{b}$ |
| 7 | 2.27±0.04$^{c}$ | 2.49±0.03$^{b}$ | 2.67±0.05$^{a}$ | 2.44±0.07$^{b}$ |
| 8 | 2.52±0.04$^{c}$ | 2.86±0.04$^{b}$ | 3.10±0.05$^{a}$ | 2.81±0.09$^{b}$ |
| 9 | 2.86±0.04$^{c}$ | 3.30±0.05$^{b}$ | 3.54±0.05$^{a}$ | 3.17±0.10$^{b}$ |
| 10 | 3.19±0.06$^{c}$ | 3.73±0.05$^{b}$ | 4.00±0.05$^{a}$ | 3.57±0.11$^{b}$ |
| 11 | 3.55±0.05$^{d}$ | 4.20±0.05$^{b}$ | 4.49±0.06$^{a}$ | 3.93±0.11$^{c}$ |
| 12 | 3.91±0.05$^{d}$ | 4.67±0.05$^{b}$ | 4.94±0.05$^{a}$ | 4.33±0.13$^{b}$ |
| 13 | 4.26±0.04$^{d}$ | 5.12±0.04$^{b}$ | 5.43±0.05$^{a}$ | 4.76±0.11$^{c}$ |
| 14 | 4.61±0.04$^{d}$ | 5.63±0.05$^{b}$ | 5.93±0.07$^{a}$ | 5.18±0.12$^{c}$ |
| 15 | 4.95±0.05$^{d}$ | 6.10±0.04$^{b}$ | 6.45±0.07$^{a}$ | 5.59±0. 11$^{c}$ |

Means with the same letter are not significantly different

Table 4: Dry matter intake percentage of body weight of cross-bred heifer calves

| | Treatment groups | | | |
|---|---|---|---|---|
| Age (months) | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| 4 | 2.34±0.02$^{d}$ | 2.36±0.04$^{c}$ | 2.49±0.01$^{a}$ | 2.47$^{b}$ |
| 5 | 2.38±0.01$^{b}$ | 2.41±0.00$^{b}$ | 2.51±0.02$^{a}$ | 2.48±0.03$^{a}$ |
| 6 | 2.41±0.01$^{b}$ | 2.44±0.01$^{b}$ | 2.54±0.01$^{a}$ | 2.52±0.01$^{a}$ |
| 7 | 2.52±0.00$^{b}$ | 2.52±0.01$^{b}$ | 2.57±0.01$^{a}$ | 2.54±0.01$^{b}$ |
| 8 | 2.48±0.02$^{c}$ | 2.53±0.01$^{cb}$ | 2.59±0.02$^{a}$ | 2.56±0.01$^{ab}$ |
| 9 | 2.52±0.02$^{b}$ | 2.56±0.01$^{ab}$ | 2.59±0.02$^{a}$ | 2.56±0.01$^{ab}$ |
| 10 | 2.54±0.02$^{b}$ | 2.58±0.01$^{ab}$ | 2.60±0.02$^{a}$ | 2.60±0.01$^{a}$ |
| 11 | 2.57±0.01$^{b}$ | 2.60±0.01$^{ab}$ | 2.62±0.01$^{a}$ | 2.59±0.02$^{ab}$ |
| 12 | 2.60±0.01$^{a}$ | 2.62±0.01$^{a}$ | 2.61±0.01$^{a}$ | 2.59±0.02$^{a}$ |
| 13 | 2.60±0.00$^{a}$ | 2.62±0.00$^{a}$ | 2.62±0.01$^{a}$ | 2.62±0.01$^{a}$ |
| 14 | 2.62±0.00$^{b}$ | 2.64±0.00$^{a}$ | 2.63±0.00$^{ab}$ | 2.62±0.01$^{ab}$ |
| 15 | 2.63±0.00$^{a}$ | 2.65±0.01$^{a}$ | 2.65±0.01$^{a}$ | 2.63±0.01$^{a}$ |

Means with the same letter are not significantly different

of the feed in the study ranged from 1.20% in Mp chari to 10.03% in mustard cake. The CF contents of feed in the present observation were varying from 2.01% in maize to 38.40% in wheat straw. Similarly, the NFE content of feeds ranged from 37.00% in cow pea to 84.30% in maize. The ash contents of the feeds in the study varied from 2.00% in maize to 8.25% in arhar chuni. The results of present study were in agreement with findings of Ranjhan (1998).

**Dry matter intake:** The mean DMI and DMI (percentage of body weight) in HS and JS cross-bred heifer calves fed different level of feeds are presented in Table 3-4. The total DMI for $T_3$ and $T_2$ diets were higher ($p<0.05$) than those heifers fed $T_1$ and $T_4$ diets. When DMI (percentage of body weight) was compare between all groups than we found that $T_2$ and $T_3$ groups was slightly higher from $T_1$ and $T_4$. DMI percentage of body weight in different treatment groups were found to be non significant ($p>0.05$).

This is in agreement with the reports of Bhat *et al*. (2013), who reported that the daily DMI of calves, between 3 and 12 months of age, was 1.45±0.08, 1.34±0.04 and 1.32±0.03 kg and the daily DMI of above 12 month old heifers was 2.95±0.15, 3.42±0.17 and 2.35±0.18 kg ($p>0.05$). These findings were similar to those of Huuskonen *et al*. (2009), who reported (1) Low level (1.75 kg dry matter day$^{-1}$) of Rolled Barley (LB), (2) Low level (1.75 kg DM day$^{-1}$) of commercial pelleted concentrated (MC) of growing dairy heifers and (Iraira *et al*., 2012) on simmental heifers and also its previously observed that dry matter intake was lowest for the TMR treatment compared with the treatments with extra (5.7 vs.7.3 kg day$^{-1}$) on dairy heifers.

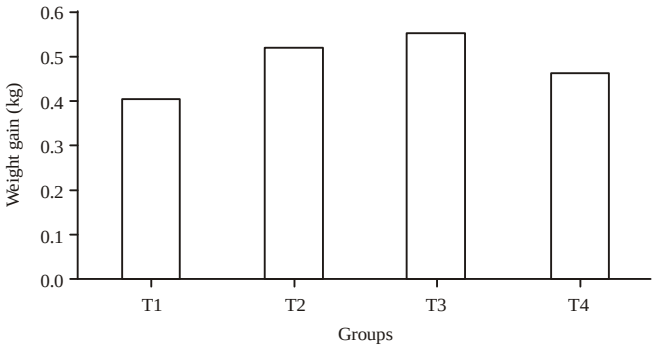


Fig. 1: Effect of different feed combinations on average daily gain in cross-bred heifer calves

Table 5: Effect of different feeds on body weight gain (kg) of cross-bred heifer calves

| | Treatment groups | | | |
|---|---|---|---|---|
| Age (months) | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| 4 | 55.27±2.53$^{a}$ | 57.30±1.40$^{a}$ | 60.26±1.82$^{a}$ | 62.00$^{a}$ |
| 5 | 67.14±1.56$^{b}$ | 70.40±0.80$^{ab}$ | 72.99±1.47$^{a}$ | 73.94±0.69$^{a}$ |
| 6 | 79.06±1.55$^{b}$ | 83.47±0.89$^{b}$ | 88.43±1.29$^{a}$ | 83.93±2.39$^{ab}$ |
| 7 | 90.30±1.41$^{c}$ | 97.98±1.00$^{b}$ | 103.79±1.52$^{a}$ | 96.48±2.68$^{b}$ |
| 8 | 101.69±1.36$^{c}$ | 113.10±1.16$^{b}$ | 119.97±1.56$^{a}$ | 109.88±3.31$^{b}$ |
| 9 | 113.71±1.21$^{c}$ | 128.67±1.28$^{b}$ | 136.93±1.64$^{a}$ | 123.49±3.61$^{b}$ |
| 10 | 125.44±1.32$^{d}$ | 144.65±1.36$^{b}$ | 153.85±1.67$^{a}$ | 137.62±3.78$^{c}$ |
| 11 | 138.05±1.25$^{d}$ | 161.40±1.55$^{b}$ | 171.56±1.89$^{a}$ | 152.07±3.99$^{c}$ |
| 12 | 150.46±1.37$^{d}$ | 178.33±1.56$^{b}$ | 189.25±2.09$^{a}$ | 166.87±4.11$^{c}$ |
| 13 | 163.62±1.16$^{d}$ | 195.71±1.60$^{b}$ | 207.17±2.27$^{a}$ | 182.19±4.24$^{c}$ |
| 14 | 175.89±1.40$^{d}$ | 213.08±1.62$^{b}$ | 225.55±2.38$^{a}$ | 197.57±4.34$^{c}$ |
| 15 | 188.42±1.74$^{d}$ | 230.65±1.68$^{b}$ | 243.37±2.37$^{a}$ | 212.66±4.31$^{c}$ |
| Average increase | 133.15 | 173.35 | 183.11 | 150.66 |

Means with the same letter are not significantly different

**Body weight gain and average daily gain:** The average weights of cross-bred heifers from 4-15 months of age are presented in Table 5. The maximum body weight gain by the heifer calves was observed in $T_3$ (243.37), where as minimum was in $T_1$ (188.42) group ($p<0.05$). However, the average total weight gain in $T_3$ was found to be 27.28, 17.72 and 5.33% higher than $T_1$, $T_4$ and $T_2$ groups, respectively. In case of $T_2$ average total weight gain was 23.20 and 13.10% higher than $T_1$ and $T_4$ groups, respectively. When body weight gain compared between two breeds, the percent body weight gain of $B_2$ breed calves (73.56) was recorded slightly higher than $B_1$ breed (73.50). The H×S cross-bred heifers were heavier than J×S at all stages from 4-15 months age and the differences were statistically non significant ($p>0.05$).

The average daily growth rate from 4-15 months of age was calculated for all groups. The rate of daily live weight gains was observed higher under $T_3$ (0.550 kg day$^{-1}$ per heifer) followed by $T_2$ (0.520 kg day$^{-1}$ per heifer), $T_4$ (0.460 kg day$^{-1}$ per heifer) while, minimum daily live weight was recorded under $T_1$ (0.400 kg day$^{-1}$ per heifer) groups, respectively (Fig. 1). This might be attributed to increase level of protein content of feed and digestibility of nutrients.

Similar results were observed by Zaman *et al*. (1983), the growth rate in F×S, J×S and Friesian×Non-descript (F×ND) females calves was 0.53, 0.49 and 0.43 kg, respectively and the average weight at 15 months of age in F×S and J×S was 265.76±2.72 and 241.97±3.77 kg, respectively, ($p<0.01$). Jadhav *et al*. (1992) on Holstein×Sahiwal cows having cumulative growth rate from birth to 6, 12, 18, 24 and 30 months was 545-586, 496-526, 421-457, 389-419 and

Table 6: Effect of different feeds on heart girth (cm) of cross-bred heifer calves

| | Treatment groups | | | |
|---|---|---|---|---|
| Age (months) | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| 4 | 99.90±3.10[a] | 100.50±2.50[a] | 104.50±1.11[a] | 105.30[a] |
| 5 | 102.50±1.87[b] | 104.10±1.59[b] | 108.20±0.95[a] | 108.30±1.21[a] |
| 6 | 104.80±1.53[b] | 106.30±0.98[b] | 111.20±0.91[a] | 109.00±1.71[b] |
| 7 | 107.00±1.51[c] | 109.00±0.97[b] | 114.40±1.05[a] | 111.20±1.70[b] |
| 8 | 109.20±1.50[c] | 111.80±0.96[b] | 117.50±1.14[a] | 113.60±1.63[b] |
| 9 | 111.40±1.48[c] | 114.60±0.95[c] | 121.00±1.31[a] | 116.00±1.55[b] |
| 10 | 113.90±1.48[c] | 117.50±0.94[c] | 124.60±1.49[a] | 118.90±1.52[b] |
| 11 | 116.40±1.55[c] | 120.50±0.93[b] | 128.40±1.67[a] | 121.80±1.51[b] |
| 12 | 118.90±1.54[c] | 123.60±0.89[b] | 132.30±1.85[a] | 124.60±1.45[b] |
| 13 | 121.40±1.55[c] | 126.80±0.85[b] | 136.20±2.02[a] | 127.60±1.45[b] |
| 14 | 124.00±1.56[c] | 130.10±0.81[b] | 140.40±2.19[a] | 130.70±1.47[b] |
| 15 | 126.70±1.59[c] | 133.50±0.73[b] | 144.80±2.27[a] | 133.80±1.36[b] |
| Average increase | 26.80 | 33.00 | 40.30 | 28.50 |

Means with the same letter are not significantly different

Table 7: Effect of different feeds on length (cm) of cross-bred heifer calves

| | Treatment groups | | | |
|---|---|---|---|---|
| Age (months) | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| 4 | 70.30±0.91[d] | 70.50±1.00[c] | 73.40±0.79[a] | 71.50±0.50[b] |
| 5 | 73.30±0.58[b] | 73.20±0.53[b] | 76.80±0.67[a] | 74.10±0.41[b] |
| 6 | 76.30±0.49[b] | 76.30±0.29[b] | 80.50±0.59[a] | 76.60±0.35[b] |
| 7 | 79.40±0.49[b] | 79.50±0.30[b] | 84.20±0.58[a] | 79.70±0.39[b] |
| 8 | 82.50±0.48[b] | 83.00±0.31[b] | 87.90±0.62[a] | 83.10±0.36[b] |
| 9 | 85.70±0.48[b] | 86.60±0.39[b] | 91.80±0.66[a] | 86.60±0.35[b] |
| 10 | 89.00±0.48[b] | 90.43±0.34[b] | 95.80±0.71[a] | 90.30±0.33[b] |
| 11 | 92.60±0.51[c] | 94.30±0.50[b] | 99.80±0.74[b] | 94.10±0.32[b] |
| 12 | 95.90±0.51[c] | 98.20±0.62[b] | 103.90±0.80[a] | 98.10±0.47[b] |
| 13 | 99.50±0.54[c] | 102.30±0.71[b] | 108.10±0.83[a] | 101.90±0.37[b] |
| 14 | 103.30±0.59[c] | 106.50±0.77[b] | 112.40±0.77[a] | 105.90±0.40[b] |
| 15 | 107.10±0.63[c] | 110.80±0.85[b] | 116.90±0.72[a] | 110.10±0.43[b] |
| Average increase | 36.80 | 40.30 | 43.50 | 38.60 |

Means with the same letter are not significantly different

392-419 g day$^{-1}$, respectively. Holstein-Friesian×Red Dane×Sahiwal (50×25×25) heifers were in 4 groups, the average daily body weight gain was 540, 630, 700 and 760 g, respectively, Holstein-Friesian×Guzera, Ahmad *et al*. (2004) on Holstein Friesian heifers, Le Cozler *et al*. (2010) on Holstein and Normande heifers and Rincker *et al*. (2008) on prepubertal dairy heifers.

**Body measurements:** During the experimental period monthly body measurements (cm) i.e., heart girth, length and height were recorded and presented in Table 6-8. The highest heart girth, body length and body height were recorded in $T_3$ and lowest in $T_1$ followed by $T_2$ and $T_4$ groups, respectively. There was significant difference were observed in heart girth, length and height in cross-bred heifers ($p<0.05$). When heart girth, body length and body height was compare between two breeds during entire period the average increases was higher in $B_1$ breed than $B_2$ breed ($p>0.05$) while, body length was found to be significant ($p<0.05$).

**Age at puberty:** In order, study of the weight of heifer age at puberty in different feed combinations have been given in Table 9. On-set of first heat is a universally accepted sign of puberty. To study the age and live weight of crosses of all parentages, daily use of sexually active teaser bull was started at the age of twelve to fifteen months. The months of appearance of first heart and body weight were recorded. When we talk about weight and age at puberty of heifer

Table 8: Effect of different feed on body height (cm) of crossbred heifers calves

| | Treatment groups | | | |
|---|---|---|---|---|
| Age (months) | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
| 4 | 92.13±0.40$^{a}$ | 92.25±1.25$^{a}$ | 93.60±0.57$^{a}$ | 92.00±0.66$^{a}$ |
| 5 | 95.10±0.30$^{a}$ | 94.50±0.43$^{a}$ | 95.40±0.47$^{a}$ | 94.90±0.39$^{a}$ |
| 6 | 97.20±0.30$^{a}$ | 96.60±0.37$^{a}$ | 97.70±0.53$^{a}$ | 96.80±0.42$^{a}$ |
| 7 | 99.40±0.27$^{a}$ | 98.90±0.40$^{a}$ | 100.40±0.55$^{a}$ | 90.10±0.43$^{a}$ |
| 8 | 101.70±0.23$^{ab}$ | 101.40±0.38$^{b}$ | 103.10±0.61$^{a}$ | 101.50±0.43$^{a}$ |
| 9 | 104.10±0.26$^{b}$ | 104.10±0.35$^{b}$ | 105.90±0.61$^{a}$ | 104.00±0.43$^{b}$ |
| 10 | 106.60±0.24$^{b}$ | 106.90±0.33$^{b}$ | 109.10±0.63$^{a}$ | 106.50±0.41$^{b}$ |
| 11 | 109.20±0.25$^{b}$ | 109.80±0.32$^{b}$ | 112.10±0.73$^{a}$ | 109.20±0.37$^{b}$ |
| 12 | 111.70±0.26$^{b}$ | 112.60±0.35$^{b}$ | 115.30±0.80$^{a}$ | 111.90±0.33$^{b}$ |
| 13 | 114.30±0.34$^{b}$ | 115.50±0.37$^{b}$ | 118.50±0.88$^{a}$ | 114.70±0.33$^{b}$ |
| 14 | 117.00±0.43$^{b}$ | 118.60±0.37$^{b}$ | 121.80±0.98$^{a}$ | 117.60±0.28$^{b}$ |
| 15 | 119.75±0.44$^{c}$ | 121.75±0.37$^{b}$ | 124.90±0.94$^{a}$ | 120.60±0.18$^{bc}$ |
| Average increase | 26.35 | 29.50 | 31.30 | 28.60 |

Means with the same letter are not significantly different

Table 9: Age and weight of cross-bred heifers at puberty

| Groups | No. of animals | Average weight (kg) | Age (months) | Heifers in puberty |
|---|---|---|---|---|
| $T_1$ | 6 | 188.42 | 15 | 0 |
| $T_2$ | 6 | 230.65 | 15 | 3 |
| $T_3$ | 6 | 243.37 | 15 | 6 |
| $T_4$ | 6 | 212.66 | 15 | 0 |

calves were found to be superior $T_3$ than $T_2$. In $T_3$ combinations there were all cross-bred heifers (100%) comes in puberty at 15 months of age than $T_2$ (50%) cross-bred heifers comes in puberty and rest of two were found no any animals comes in puberty. The results are agreement with reported by heifers are required to conceive successfully by 15 months of age, Bhatti *et al*. (2007), Boulton *et al*. (2012) and Byerley *et al*. (1987) heifers to conceive by 14-15 months of age and Daccarett *et al*. (1993).

## CONCLUSION

It is calculated that 50% Maize+30% MC+10% AC+8% WB 2% MM, enhanced growth parameters, feed utilization and reproductive performance of cross-bred heifer calves in terms of age at puberty during 4-15 months of age was achieved higher under local environmental conditions of India.

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