RELIABILITY OF UNIFIED SCORE CARD FOR CROSSBRED DAIRY COWS OF KERALA

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DECLARATION

I hereby declare that this thesis, entitled **"RELIABILITY OF UNIFIED SCORE CARD FOR CROSSBRED DAIRY COWS OF KERALA"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CONTENTS

Chapter	Title	Page No.
1	INTRODUCTION	1
2	REVIEW OF LITERATURE	3
3	MATERIALS AND METHODS	25
4	RESULTS	30
5	DISCUSSION	49
6	SUMMARY	60
	REFERENCES	64
	APPENDIX	
	ABSTRACT	

LIST OF TABLES

Table No.	Title	Page No.
4.1	Average, minimum and maximum scores for type components and final score	31
4.2	Average, minimum and maximum final score for different age groups, parities and stages of lactation	32
4.3	Mean scores of type components for different age groups	34
4.4	Mean scores of type components for different parities	35
4.5	Mean scores of type components for different stages of lactation	36
4.6	Average lactation yield for different age groups	38
4.7	Average lactation yield for different parities	38
4.8	Correlations between major type components	39
4.9	Correlations of major type components and final score with milk yield	42
4.10	Regression of type components on milk yield	42
4.11	Regression of traits under the type components on milk yield	43
4.12	Average, minimum and maximum values of body measurements	44
4.13	Means of body measurements for different age groups	45
4.14	Means of body measurements for different parities	46
4.15	Correlations of type components with measurement	48

LIST OF FIGURES

Figure No.	Title	Page between
1	Minimum and maximum final score for different age groups	32-33
2	Minimum and maximum final score for different parities	32-33
3	Minimum and maximum final score for different stages of lactation	32-33
4	Average lactation yield in kg for different age groups	38-39
5	Average lactation yield in kg for different parities	38-39
6	Average height in cm for different age groups	45-46
7	Average length in cm for different age groups	45-46
8	Average in girth in cm for different age groups	45-46
9	Average height at hooks for different age groups	45-46
10	Average hip width in cm for different age groups	45-46
11	Average height for different parities	46-47
12	Average length in cm for different parities	46-47
13	Average girth in cm for different parities	46-47

LIST OF PLATES

Plate No.	Title	Page between
1	Ideal rump with minimum slope between rump and pins	48-49
2	Droopy rump with low lying pins	48-49
3	Straight topline	48-49
4	Raised tail head	48-49
5	Good depth and spring of both fore and rear ribs	48-49
6	Shallow ribbed animal with barrel shaped body	48-49
7	Adequate width at chest but toes turned out	48-49
8	Poor width of chest floor and between knees	48-49
9	Legs placed far apart	48-49
10	Closely placed legs with toes turned out	48-49
11	Ideal rear legs with optimum curvature at hocks	48-49
12	Ideal pastern with depth of heel and a level sole	48-49
13	Sickle shaped legs with weak pasterns, and a shallow heel	48-49
14	Ideal spacing of teats	48-49

15	Closely placed teats	48-49
16	Funnel shaped teats	48-49
17	Unsymmetrical and misshapen teats	48-49
18	Fore udder attachments optimum but tapering teats	48-49
19	Slightly tilted udder	48-49
20	Unequal sized teats	48-49
21	Teats lacking symmetry	48-49
22	Udder with plenty of room between the hocks, ideal cleft indicative of strong median suspensory ligament	48-49
23	Good symmetry of udder but more pronounced udder cleft and inadequate udder tissue	48-49
24	Broken udder attachments and low lying udder	48-49

Dedicated to My Family

Introduction

1. INTRODUCTION

Though the Indian economy has stepped upon the accelerator with its industry tycoons grabbing banner headlines, agriculture remains one of the major revenue and employment generating sector. Livestock production being one of the most important sources of livelihood of farmers in India is an important branch of the sphere of agriculture. Over 70 percentage of the rural households in India depend on livestock farming for supplementary income. Out of total livestock in the country, 38.2 percent are cattle. India has 187.38 million cattle out of which 22.63 million were crossbred (Anon, 2003). The cattle population in the State is 21.22 lakhs of which 17.35 lakhs were crossbred i.e. 81.8% of the total cattle population comprises crossbred. In short, the livelihood of rural household owes much to the crossbred cattle and an average producing animal does not hold good in this scenario.

A dairy animal is desirable only if it can achieve a high standard of production and maintain that standard throughout a long life (Trimberger, 1977). The goal of dairy farmers is to breed the most profitable dairy cows. High-yielding dairy cows completing many lactations without problems contribute significantly to this ultimate goal. Lack of good animals was pointed out as an important drawback of the present cattle farming. It can be in other words, failure to identify good animals may be the failure of a farmer to get a good animal. To identify the best among the herd while purchase of animals relies mainly upon the records and the visual appraisal gets limited to the udder alone.

For as long as humans have domesticated animals, livestock judging has been a critical skill. Dairy cattle judging has been very important to dairy farmers and dairy cattle breeders for years. It was initially conducted as a means to help identify genetically superior animals for use as the parent stock of future generations. Visual appraisal of the physical traits continues to be a part of the genetic evaluation of dairy cattle to optimize profit (Guthrie and Majeskie, 1997). Although in modern times the judging of cattle usually occurs in show rings, in both the past and present it is also a guide to purchasing animals.

In 1943, the Purebred Dairy Cattle Association developed the Dairy Cow Unified Score Card, which was revised in 1957, 1971, 1982, and 1994 to reflect important changes in functional type traits. The score card is a concise description of the conformation of body desired with a numerical expression of the relative importance of each point considered. (Eckles *et al.*2000). It is used by professionals to evaluate cattle in the physical type classifications program and has played an important role in educating youth on the evaluation of dairy cattle. The score card is used as a basis to evaluate the physical traits relative to economic importance and to formulate logical reasons for placing of dairy cattle at contests and shows.

Evaluation of type conformation for predicting milk production will be useful for farmers in selecting the animals where production records are not available. Functional conformation traits contribute positively to trouble-free milk production, since it influences the longevity and workability of the cow. Whether the crossbred cows can be judged by the same score card used for purebred cows, whether the score card is reliable for our crossbred cows remains questionable. In this scenario, the present study is undertaken,

1) To estimate the relationship between type components and milk yield,
2) To measure the magnitude and direction of type components and milk yield with age, parity and stage of lactation
3) To assess the reliability of Unified score card for crossbred cows in Kerala.

Review of Literature

2. REVIEW OF LITERATURE

2.1 UNIFIED SCORE CARD

Wilcox (1959) observed that cows were rated higher after the winter feeding season than summer based on score card traits viz. mammary system, body capacity, dairy character and general-appearance.

Mitchell *et al.* (1961) studied on the phenotypic and genetic correlations between type ratings and milk and fat production in Holstein-Friesian cattle and found that general appearance and final type score were highly correlated.

Butcher *et al.* (1963) used intra-sire-herd variances and covariances of daughters and dams to estimate heritabilities and phenotypic and genetic correlations on 8165 daughter-dam pairs located in 2924 sire-herd groups. He observed that the phenotypic correlations between the component of type and final type rating were high, ranging from 0.35 to 0.62.

Ratings of dairy character were more closely related genetically and phenotypically with production than final score and had shown more promise for use in selection. The description of dairy character on the score card concerned evidence of milking ability as shown by sharpness and openness (Atkeson, 1969).

According to Purebred Cattle Association Unified Score Card, general appearance and mammary system should receive 1-5 times as much emphasis as dairy character and body capacity. However, general appearance and mammary system appeared to receive more weight scorecard designates for these characteristics as per the findings of Hansen *et al.* (1969). The results of his study indicated that emphasis placed on type components was different from that prescribed by the purebred Dairy Cattle Association Dairy Cow Unified Score Card.

Trimberger (1977) explained the use of the unified score card for type evaluation. He adopted the Unified Score Card based on the fundamental concept that a dairy animal had certain common characteristics that were more basic than particular shape, colour and other breed characteristics.

Unified score cards had been developed in the West for evaluating the dairy type and conformation of cows and bulls. Different body parts and features were given different weightages depending on their relative importance to the formation of the overall type conformation of the cow. A cow with high type score was deemed nearer to the ideal dairy cows than a cow with lower type score. Such score card traits could increase accuracy of selection for milk production as they were highly heritable and closely related to milk production (Thomas and Sastry, 1991).

Van Dorp *et al.* (1998) used a total of 4368 first lactation records for Holstein cows from 30 herds to estimate genetic parameters of health disorders and relationships with 305-day milk yield and conformation traits. His finding was that selection, if based solely on yield might increase the incidence of disease whereas, selection for conformation traits could help reduce the incidence of disease.

Anitha *et al.* (2005) opined that though dairy cow unified score card formulated by the Purebred Dairy Cattle Association, USA (1994) was used as a good tool for evaluation of a dairy cow, it might not be much useful tool for a farmer because of more technicality involved in it and breed characters should always be considered in its application.

2.1.1 Linear type traits

Vinson *et al.* (1982) used the Holstein Friesian Association of America data on five Virginia herds to identify relationships between linear scores and various body measurements and concluded that differences in linear scores seemed to identify conformational differences found by measurement.

Thompson *et al.* (1983) evaluated a linear type programme of the Holstein Friesian association of America and found heritabilities for 14 linear traits ranging from 0.12 to 0.32 and genetic correlations ranging from 0.59 to 0 .95.

Results of study of Ali *et a*l. (1984) showed that as in the case of simple correlations, that capacity, size, and stature had the highest correlations with each of the height characteristics, heart girth, and rump compared with the other type traits. The high correlations indicated that traits were genetically similar and that selection for one characteristic should improve the correlated one as well.

Genetic correlations ranged from -0.50 between dairyness and basic form to 0.91 between basic form and strength. Large genetic correlations seemed associated with traits in close physical proximity (i.e., rear udder height and width) or traits that were similarly defined (i.e., basic form and strength). Positive genetic correlations indicate selection for increased scores in one trait would be accompanied by increased scores in the correlated trait, regardless of the direction of the score that improved the trait (Foster *et al.*, 1988).

Selection emphasis on type traits associated with increased herd life might be beneficial to decrease involuntary culling and increase profitability (Rogers *et al.*, 1989).

Dairy producers consistently ranked udder traits and feet and leg traits as the most important conformation traits associated with profitable dairy cattle (Burke and Funk, 1992).

Misztal *et al.* (1992) found that heritabilities for type traits ranged from 0.10 to 0.42; the largest was for stature . Genetic correlations between all yield and most type traits were positive (from 0.01 to 0.68); except for fore udder attachment, udder depth, and front teat placement(-0.01 to -0.44).

Rogers (1993) observed that selection efficiency measured by the correlation between the index and the aggregate genotype, increased slightly when udder depth, teat placement, foot angle and somatic cell score were included in the selection criteria with milk yield.

In dairy cattle, type traits were used as an early predictor of longevity (Larroque and Ducrocq, 2001).

The association of linear type traits with production efficiency indicated medium to high phenotypic and genetic correlations of production efficiency with most of the udder traits (Dahiya and Rathi, 2002).

Estimates of genetic correlations among linear type traits ranged from -0.77 to 1.00. Means of estimated breeding values for final score, stature, strength, body depth, fore udder attachment, rear udder height and width, udder cleft, udder depth, and front teat placement were significantly different between lines in the third generation (DeGroot *et al.*, 2002).

Gutierrez and Goyache (2002) opined that type traits could be used as indirect selection criteria for herd life.

Type traits were recorded relatively early in life, most often in the first lactation, and were more highly heritable than longevity which made selection on them relatively more efficient (Kadarmideen and Wegmann, 2003).

In his study of genetic relationships among linear type traits, milk yield, body weight, fertility and somatic cell count in primiparous dairy cows, Berry *et al.* (2004) found that genetic correlations between all type traits (except Body condition score , udder depth and teat length) and milk yield were positive.

Among the linear type traits, udder traits such as fore attachment, udder texture, and udder depth were the most important with a strong relationship with functional survival of cows. Udder depth, rump angle, and rear legs side view showed an intermediate optimum with regard to functional longevity (Sewalem *et al.,* 2005).

Research in the area of cattle breeding was more and more aimed at identifying new selection criteria, which would contribute to the genetic improvement of economically important traits with low inheritance. One of the possible solutions was to use indirect selection for these characteristics through selection for animal type traits (Bouska *et al.*, 2006).

2.1.1.1 Frame

Hansen *et al.* (1969) observed that general appearance and final type score were highly correlated. The first month was above the average, and the third month was below the average; both were significant ($p<0.01$)

In the study of Dahiya and Rathi (2002) on the identification of type indicators for prediction of production efficiency in Indian cattle, the magnitude of correlations of stature and chest and body with production efficiency($rp = 0.23 \pm$

0.12 to 0.55 $\pm$ 0.06) indicated that tall and wide cows were more productive per unit of time as compared to short & trait cows..

2.1.1.2 Dairy character

Selection based on type ratings, with the exception of rating for dairy character, would cause little genetic improvement in milk or milk fat production. The relative genetic progress in milk production, if selection is on dairy character, is expected to be 35 to 50% of that which can be obtained by selecting based on one milk production record (Mitchell *et al.*, 1961).

Dairy character was rated higher at the beginning and end of lactation with the third month being highest. The interaction of age and stage of lactation was significant only for dairy character. Stage of lactation had little effect on dairy character at two years of age. At older ages however, the effect of stage of lactation on dairy character became more pronounced, with cows scoring lower during the latter part of lactation (Hansen *et al.*, 1969).

Phenotypic correlations indicated that cows scored high for dairy character also were scored taller, wider at the rump, more sickled at the hock, higher and wider in rear udder, with more cleft to the udder floor and closer teat placement than cows scoring low in dairy character (Thompson *et al*,1983).

Misztal *et al.* (1992) concluded that found that dairy form had the largest genetic correlations with yield traits, which ranged from 0.59 with milk to 0.68 with fat.

Regression coefficients for dairyness traits were extremely small, however, indicating that influences of such relationships on functional herd life were of minor importance (Boettcher *et al.*, 1997).

The negative correlation of dairy form with all measures of productive life indicated that today's cows might be too effective at converting their body reserves into usable energy, whereby they were at an elevated risk level of being culled throughout their entire life (Bouska *et al.*, 2006).

2.1.1.3 Body capacity

The scores for body capacity declined sharply from the first month until the third month of lactation. Months, 1, 3 and 10 were all significantly different from the average ($p<0.01$). Months 1 and 10 were above the average and month 3 was below the average (Hansen *et al.* 1969).

Although body capacity received the least amount of consideration when classifying cows and on the PDCA dairy score card it still plays a crucial role in dairy cattle. As ruminants and milk producers, cows needed to consume large volumes of forage and without adequate body capacity it would become difficult for cows to achieve high production levels (Hoard, 1999).

Eckles *et al.* (2007) opined that a heavy producing dairy cow must have large organs of digestion in order to utilize the enormous quantities of feed necessary to produce large quantities of milk.

2.1.1.3 Feet and legs

Atkeson (1969) stated that feet and legs practically had no influence in final score although in young cows, a larger score for feet and legs caused the final score to decrease after adjustment for other components.

Baumgartner *et al.* (1990) found that judgments of front legs were also more heritable than those of rear legs where they were scored. Four of the six front leg or claw traits were more heritable than their rear counterpart.

Shapiro *et al.* (1991) opined that although no direct link appeared to exist between rear leg rear view and fertility or milk production, a low-scoring animal might have greater fertility problems and lower milk production because of reduced mobility.

Rear legs rear view was moderately correlated with rear udder height and width. Genetic and phenotypic correlations between rear leg and rear udder height were 0.29 and 0.25, and correlations between rear leg view and rear udder width were 0.35 and 0.28 (Short *et al.*, 1991).

Burke and Funk (1993) addressed the relative importance of feet and legs to predict survival for different housing types and foot trimming routines .They found that cows with steeper hoofs phenotypically and genotypically had a prolonged herd life. Cows with genetic merit for straighter rear legs had slightly longer herd life than cows with more curved rear legs. Even if herd life was shorter for cows with phenotype for extremely straight or extremely curved rear legs, results from this study suggested that limited opportunity existed for dairy producers to improve curvature of the rear legs genetically by selection in an effort to extend herd life.

The Dutch feet-leg index was strongly related with percentage culled by the third calving (De Jong, 1994), with the culling rate decreasing from 56% for the lowest indexed decile to only 24% for the highest decile.

Dekkers *et al.* (1994) revealed that the Canadian index of feet and legs was significantly correlated with length of productive life.

Uribe *et al.* (1995) found the heritability of "culled for leg problems" to be 0.15. This was a particularly high value for a trait with low frequency as it was identified as responsible for only 3.5% of the cullings.

Breeding values for foot traits scored or measured in first lactation had generally been negatively correlated with those for milk production (Boelling and Pollott, 1997). These results indicated that lameness would increase as a consequence of selection for increased yields unless foot and leg traits were also considered in selection decisions.

Generally when compared scores of rear legs rear view had been more highly correlated with survival than those of rear legs (Boettcher *et al.*, 1997).

According to McDaniel (1997) foot and leg problems and other locomotor disorders were the most important reason for involuntary culling after reproduction and mastitis. He opined that the most practical way to improve locomotion in dairy cattle, based on research, seemed to be use of a foot-leg index that includes claw diagonal if available and foot angle if it is not, leg score (especially from the rear), and a locomotion score. This did not mean that foot angle needed to be discarded but that other measures be used to supplement and possibly replace it. Until the scores on the additional traits were widely available, foot angle might be the primary selection criteria for feet with some lesser emphasis on legs.

Warnick *et al.*(2001) opined that since an animal with bad locomotion would not easily gain access to feed and the milking parlor, profitability, labor, and animal welfare would be affected.

Results from Van Dorp *et al.* (2004) indicated that cows with better scores for feet and legs (FL), Foot angle(FA), RLS, and strong udder attachments had more favorable locomotion.

The emphasis placed by dairy producers on locomotion traits was clearly supported by the results of the study of Perez-Cabal *et al.* (2006). He observed that cows with higher scores for feet and legs and intermediate scores for foot angle and rear leg set showed better performance in terms of production and longevity. The cows that scored the highest for Feet and legs, produced 575 kg more milk per year, and remained in the herd for 307 more functional days than the cows scoring the lowest. Feet and legs was the trait most genetically correlated to profit, although a low value (0.10) was obtained , whereas rear leg set was the trait most correlated to milk production (0.12).

Wiggans *et al.* (2006) found that for Brown Swiss, heritability was 0.102 for rear leg rear view (RLRV) and ranged from 0.099 for rear legs (side view) to 0.453 for stature. For Guernseys, heritability ranged from 0.078 for RLRV to 0.428 for stature. For Brown Swiss, the highest genetic correlation with RLRV was 0.71 for rear udder width; the most negative correlation was −0.19 with rump angle. For Guernseys, the highest genetic correlations with RLRV were 0.43 for rear udder width and 0.42 for body depth; the most negative correlation was −0.46with rear legs (side view).

2.1.1.5 Udder

The mammary system rating in the seventh month of lactation showed the lowest average among type component. For mammary system, months 1 and 7 were significantly different from the average(p<.01), month 1 being higher and 7 lower than the average (Hansen *et al.*, 1968)

Swaid and Sastry (1982) found that shape and size of udder and teats had been found to affect test milk yield in crossbreds. The rate of milk flow out of the udder (1.0kg/min) as well as test milk yield (10-12 kg) were found to be highest in case of crossbred cows possessing collapsible udders.

Basic form and strength of body were not highly correlated with any of the udder traits. Therefore selection on any on either basic form or strength of body would leave udder characteristics unaltered (Foster *et al.*, 1988).

Norman *et al.* (1988) calculated genetic correlations between first lactation yields and linear type traits for Guerenseys and Jerseys. Largest negative genetic correlations with yield were -0.59 and -0.56 for udder depth and fore udder attachment in jerseys and -0.29 and -0.25 for foot angle and thurl width in Gurenseys. For both breeds, largest positive correlations with yield were for dairy character. Genetic correlations between milk yield and final score were 0.25 for Guerenseys and 0.21 for jerseys.

Fore udder attachment, udder cleft, and udder depth had a negative association with milk yield, whereas rear udder height and rear udder width have a small positive relationship (Foster *et al.*, 1989).

Phenotypic correlations between somatic cell counts and fore udder attachment, udder cleft, udder depth, and teat placement were all negative, which indicated that cows with higher, more tightly attached udders and closer teats had lower counts(Rogers *et al.*,1991).

Short *et al.* (1991) found that the highest genetic correlations between teat length and the other udder traits were with udder depth (-0.21) and front teat placement (-0.28). Teat length should be included as a primary type trait because it had moderate heritability, was genetically distinct from other type traits, and had economic importance .

Burke and Funk (1993), revealed that fore udder attachment and udder depth explained the most variation when production was included in analyses. Udder depth explained the least amount of herd-life variation among six udder traits when production was not included in the analyses.

McDaniel *et al.* (1993) found that sire breeding values for udder traits were slightly more highly correlated with survival than were claw and leg traits.

Rogers (1993) found that the coefficient for udder depth was the largest, which indicated that of the nonyield traits, udder depth should receive the most emphasis. Udder depth and fore udder attachment were highly correlated and have about the same correlation with culling and udder health.

In a study of Bascom *et al.* (1998) udder conformation (8%) and low production (8%) were found to be the most common secondary reasons for removal from the herd.

Weigel *et al.* (1998) found that among the linear type traits the udder traits (+0.24 to +0.32), teat placement (+0.22), and dairy form (+0.41) had the largest correlations with production life. Udder traits had an important influence on involuntary culling decisions, mainly because of their influence on susceptibility to injuries and infections .

Kelm *et al.* (2000) reported that linear type traits in selected lines for increased milk yield did not drastically deteriorate compared with control lines; however, selected lines had cows with udders that were wider, longer, and slightly deeper.

Values of phenotypic correlation coefficients obtained between udder measurements and milk performance for the first 305 days lactation, (in the present study) were low and negative (Kuczaj, 2000).

Buenger *et al.* (2001) found cows with extremely closely placed rear teats were more likely to be culled compared with cows with extremely wide rear teats. The strongest relationships between survival and type were found for udder depth, fore udder attachment, and front teat placement.

Selection in South African Holstein cattle has been mostly on milk yield, which has a deleterious effect on udder health (Castillo-Juarez *et al.*, 2002).

The relationship of udder traits with production efficiency revealed that most of these traits had medium to high phenotypic correlations with production efficiency. The direction of association of udder traits with production efficiency pointed that cows with loose attachment of fore udder wide and high rear udder , wide teat placement at base and having deep udders with clearly defined halving were more efficient in production (Dahiya and Rathi, 2002).

The relationship between udder fore depth, rear teats span, and udder volume and somatic cell count were statistically significant ($P < 0.05$), while between teat diameter, distance to the floor, and SCC in milk were statistically highly significant ($p < 0.01$). Therefore, selection for cows with high suspension of udders was recommended (Kuczaj, 2003).

Berry *et al.* (2004) found that strong genetic correlation existed between udder depth and fore-udder attachment (0.92); cows with shallow udders possessed tighter fore-udder attachments. Cows with genetically stronger, shallower udders had more sickled rear legs, with low foot angles; these animals were faster milkers.

Udder depth was the most important type trait with regard to functional longevity (Caraviello *et al.*, 2004).

Cows with strongly attached udders, high rear udder height, close fore teat placement and shallow udders were expected to have longer herd lives than cows without these characteristics. Selection on fore teat placement was likely to have the greatest impact on longevity as it had the highest genetic correlation with longevity (Setati *et al.*, 2004).

Udder depth and teat position side view type traits exhibited an intermediate optimum as it related to production life. Fore-udder attachment, rear-udder height, and udder support showed a clear linear relationship with production life (Sewalem *et al.*, 2004).

From the stand point of production, the essential thing was to have sufficient udder capacity to admit the secretion of large amount of milk, with teats of such size as to admit convenient milking (Eckles *et al.*, 2007).

The study by Rao *et al.* (2007) indicated that proper shape, size and measurements of the mammary gland significantly influenced milk yield, fat and protein content.

According to Ashwood (2008) the udder of a highly productive female had the capacity to produce and deliver sufficient milk for high weaning weights and retained physical characteristics that allowed repeated calvings. The most desirable udder was one that provides sufficient levels of milk from the smallest amount of mammary tissue .

2.1.1.6 Final score

Hansen *et al* . (1968) observed that the final scores for first and seventh months of lactation were significantly different from the average of all months($p<0.01$). Cows averaged 0.82 point above the mean in the first month and

0.42 point below the mean in the seventh month of lactation. The greatest difference caused by age was 3.74 points and by stage of lactation was 3.04 points.

DeGroot *et al.* (2002) found that final score was positively genetically correlated with body and udder traits with estimates that ranged from 0.38 for dairy form to 0.88 for rear udder width. These estimates indicated that selection for final score would increase body size and strengthen the overall composition of the udder in the herd.

2.2 BODY MEASUREMENTS

Davis *et al.* (1961) indicated that previously derived body weight estimations used heart girth most often because heart girth exhibited the highest correlation to body weight, as it did in his data.

Wilk *et al.* (1963) concluded that body measurements were of little value in predicting milk production, but no basis was found for the often encountered claim of a genetic antagonism between measures of body size and milk production.

Williams *et al.* (1979) studied on repeatabilities and relationships of physical measurements with milk production and found that wither height and hip height were closely correlated and were positively correlated with all physical traits. Cow physical measurements were highly repeatable but were not closely associated with estimates of milk production. He suggested that use of these physical measurements to select indirectly for milk production would be ineffective.

Shanks and Spahr (1982) opined that hip height and hip width indicated body frame available to support the cow, mammary system, and milk production .

Ali *et al.*, (1984) observed that hip to pin and hip to thurl were highly correlated (0.81).These high positive genetic correlations indicate that these traits are genetically similar and that selection programs aimed at increasing one trait should result in positive responses by the correlated traits as well.

Milk production traits were all positively correlated with body measurements, suggesting that high producing heifers would be taller, larger, and longer than low producing heifers (Lin *et al.*, 1987).

Wither height was positively correlated (P~0.05) with yield traits in first parity, was not significant in second parities, and was higher in significance (P~<0.01) in all lactations. Over all lactations, however, taller cows tended to produce significantly more milk than shorter cows. Analyses of chest depth measurements showed a similar pattern to those for wither height, indicating that cows with deeper chests had higher milk yields (Sieber *et al.*, 1988).

Heinrichs *et al.*(1992) opined that wither height, hip width, or body length, which all reflected skeletal growth, were equally important functions to consider because those body dimensions were not often influenced by body condition or degree of fatness. The R2 values from the regressions showed heart girth and hip width to be the most highly related to body weight, although all R2 were above 0.9.

Phenotypic correlation coefficients between milk performance traits and body measurements were low in values and quite often negative. The only strong relation for the 305 days of lactation was reported between milk protein content and the depth of chest ($r = -0.39$; $p<0,01$) (Kuczaj *et al.*,2000).

Wither height, hip height and hip width are indicators of skeletal development that are relatively easy to obtain precisely because the anatomical locations for measurement are easy to identify. Hip height appeared to be smallest for cows of parities 4 to $\geq$ 5. Mean height was numerically lower for cows in their third or greater lactation than younger cows. (Enevoldsen and Kristensen, 1997)

In the study of Kertz *et al.* (1997) on 728 cows and heifers, the maximum wither height was 144 cm, and the initial height for first parity heifers was 138 cm.Wither height averaged 138 cm at first parity and increased 3 cm from first to second parity. During fifth and sixth parities, wither height peaked at an additional 2 to 3 cm.

The significant magnitude ($P<0.01$) of correlation of b0dy weight with various body measurements indicated that increase in the various body measurements were associated with the increase in body weight of the animals. The prediction equations developed to predict the body weight from the body measurements gave an accuracy of 72.24 percent (R^2) in KF cows and 66.90 per cent (R^2) in Murrah buffaloes. Body measurements, mainly heart girth and abdominal girth were better related with body weight in both the breeds, KF cows ($r = 0.78$ and 0.74) and Murrah buffaloes($r = 0.72$ and 0.75). So, heart girth or abdominal girth can alone be used for prediction of body weight (Bhakat *et al.*, 2008).

Rump height which was a measure of stature was observed to be a highly heritable trait. Its genetic correlation with longevity was close to zero, however, indicating a very weak relationship with longevity (Setati *et al.*, 2004).

Genetic and phenotypic correlations between body weight and other linear body measurements were consistently high and positive meaning that similar genes are controlling them all and thus selection for one would lead to positive correlated effect on the other (Abdullah and Olutogun, 2006).

2.2 AGE AND PARITY

Barr *et al.* (1970) found that differences for age were significant for all traits except feet and legs, mammary and rear udder. Five year-olds scored highest in final score, general appearance, stature, breed character, back and rump, and chest and barrel. The traits relating to mammary system were scored higher on younger cows.

Age group was a significant (P<.01) source of variation for all traits except rear legs (rear view) and heel depth. Strength of body and udder depth, which would be expected to change with age, exhibited the largest F-ratios for age (Thompson *et al.*, 1983).

Ali *et al.* (1984) found that the effect of age of cow was significant (P<.05) for all body characteristics. Hip width, pin width, wither height, heart girth and thurl to pin increased with age. All other height characteristics increased with age up to five year and then started to decrease.

Mean scores indicated that first parity cows were scored average for most traits but tended to be evaluated as slightly dairy and deep bodied, with shallow udders, relatively straight legs when viewed from the rear, udders with good cleft, and relatively fast milkout (Foster *et al.*, 1988)

Sieber *et al.* (1988) found that the mean wither height of the research herd increased 4 cm from first to second parity and then increased an additional 1.5 to 2.5 cm by fifth parity or greater. However, the maximum wither height of cows was only 138 cm.

Enevoldsen *et al.* (1997) found that hip height appeared to be smallest for cows of parities 4 to>=5. The values of BW and hip width appeared to be smallest for first and second parity cows.

Age of the cows significantly influences the growth of values of zoometric measurements of udders, except for the distance from the udder to the floor, which decreased (Kuczaj, 2003). He demonstrated that for a cow after a number of lactations, rear teats grew more intensively than fore teats.

Islam *et al.* (2006) observed that milk production potential increased with advanced ages, parities of cows and maximum yield recorded at fourth parity.

2.4 STAGE OF LACTATION

The interaction between age and stage of lactation was significant only for dairy character. Stage of lactation had little effect on dairy character rating at two years of age. At older ages, the effect of stage of lactation on dairy character became more pronounced with cows scoring lower during the latter part of lactation (Hansen *et al.*, 1968).

Stage of lactation affected scoring for all linear traits ($P<.05$) Traits that might be affected by body weight (strength, dairy character) or edema and udder condition (fore udder attachment, udder depth) were most affected by stage of lactation as measured by the F-ratio. Body weight, edema, and udder conditions were expected to change considerably as a cow proceeded through her lactation. (Thompson *et al.*, 1983).

The effect of stage of lactation was significant ($p<0.05$) for heart girth, hip to pin, and thurl to pin . A close investigation of this effect revealed that heart girth increased as lactation proceeded. This was expected as condition of cows generally decreases after calving and early stages of lactation with a gradual increase as lactation proceeded (Ali *et al.*, 1984).

The cows with highest milk production in first lactation had maximum longevity and productive herd life of 3596.49+ 294.13 and 2463.90 +294.03 days respectively (Abbas *et al.*, 2008).

Chander *et al.* (2008) concluded that since selection on lifetime performance was not practically feasible due to long generation interval, it was desirable to select animals on the performance of earlier lactations than traits expressed later in life.

2.5 MILK YIELD.

The parts of the conformation having a distinctly significant relation to milk production of the cow were the milk veins, size and condition of udder, the size and shape of rear udder, the shape and size of barrel and the general appearance of the cow(Gowen ,1920).

Shanks and Spahr (1982) observed that greater than average daily milk production in early first lactation was associated with taller hip height, broader hip width, and deeper than average udders. Daily milk production was negatively correlated with udder depth (r = -0.18) in the first and second lactations.

Meyer *et al.* (1987) reported genetic correlations ranging from -0.52 to 0.24 between linear type scores and milk yield in primiparous British Friesians. Udder depth and fore udder attachment had largest antagonistic correlations with yield. Corresponding phenotypic correlations were smaller in magnitude and ranged from -0.27 to 0.21.Genetic correlation between milk yield and final score in first parity was -0.14.

Selection on udder traits, foot angle, and production would result in only a small increase in efficiency above selection on production alone. However, these type traits might help reduce involuntary culling or limit correlated increases in involuntary culling associated with increased milk yield (Rogers *et al.*, 1989).

Harris *et al.* (1992) pointed out that selection to improve milk production is likely to increase udder dimension and weaken fore udder attachment and depth.

According to Misztal *et al.*(1992),continued selection for milk yield would cause deterioration in some conformational traits. The udder traits would be those most affected. Selection to maintain udder depth would decrease progress for milk yield by about 15 %.

Short and Lawlor (1992) reported that the linear traits with highest genetic correlation with milk production were dairy form (0.52) and udder depth (-0.41) and that both rear udder height and rear udder width had positive genetic correlations with milk production. They found that traits associated with body size had a positive relationship with milk yield

Boettcher *et al.* (1993) reported that cows selected for milk yield in the University of Minnesota experimental herd had significantly higher estimated breeding value for stature, body depth, angularity, rump width, leg set, rear-udder height and width, udder support, and udder depth than a control line.

Selection for milk yield, somatic cell score, udder depth, teat placement and foot angle would improve efficiency of response in the aggregate genotype by one to four percent over selection of milk yield alone(Rogers,1993).

Brotherstone (1994) reported a positive genetic correlation (0.10) between udder support and milk yield and a negative genetic correlation (–0.29) between fore-udder attachment and milk yield; which was despite the strong genetic correlation between fore-udder attachment and udder depth (0.76) reported in the same study by him.

Genetic correlations between body weight and 305-day milk, fat and protein yields varied from +0.09 to +0.34 in the Ayrshire data and from -0.06 to +0.28 in the Friesian. Phenotypic correlations were slightly larger and positive in both breed (Hietanen and Ojala, 1995).

Van dorp *et al.* (1998) opined that there was a substantial genetic correlation between milk yield and udder edema, suggesting that high yielding cows had increased genetic potential to develop udder edema.

DeGroot *et al.* (2002) opined that traits related to udder attachment had a negative genetic relationship with milk yield, whereas udder capacity traits had a positive relationship with milk yield. He concluded that selection for milk yield in the herd increased udder capacity, while causing the fore attachment and cleft to weaken.

Sattar *et al.* (2005) found that, the highest (3192.23 ± 150.93 litres) and the lowest (1907.78 ± 305.40 litres) values of lactation milk yield were observed in cows during third and sixth lactation, respectively. The lactation milk yield during seventh lactation was significantly ($p<0.05$) lower when compared with that of third lactation. The lactation milk yield during sixth lactation was also significantly ($p<0.05$) lower as compared to that of third, fourth and fifth lactations.

The large development of udder and barrel was a general evidence of using the feed for milk rather than for flesh production. On the other hand there was no evidence that a level rump and dished face of certain breeds were correlated with milk production (Eckles *et al.*, 2007).

The cows with highest milk production in the first lactation had maximum longevity and productive herd life of 3596.49+294.13 and 2463.90+294.03 days respectively (Abbas *et al.*,2008).

Many researchers had reported that there was a meaningful correlation between facial type (physical form) and production. Therefore, type judging was one of the best ways for evaluating useful features. This assessment contained those features that had maximum correlation for producing milk (Alizadeh *et al.*, 2008).

Materials and Methods

3. MATERIALS AND METHODS

The resources and facilities available at the University Cattle farms at Mannuthy, Thumburmuzhi and Thiruvazhamkunnu and Department of Livestock Production Management were utilized for the study.

3.1 SELECTION OF ANIMALS

Animals under six years of age with at least one lactation were selected for the study. The heifers and animals in dry condition were excluded.

3.2 JUDGING OF ANIMALS

The animals were judged twice with an interval of one week to avoid bias on a particular day. The average score was taken as the final score.

3.2.1 Dairy cow unified score card

The animals were judged as per the Unified scorecard by Purebred Dairy Cattle Association (1994). The scorecard is appended. The type components were again subdivided as described in the score card to improve the accuracy of judging.

3.2.1.1 Frame

As per Purebred Dairy Cattle Association, fifteen points were allocated for Frame. The overall general appearance of the animal was judged. Five traits were considered under frame. The traits were rump, stature, front end, back and head. Rump was allocated four points, stature two points, front end three points, back three points and head three points.

3.2.1.2 Dairy Character

Twenty points were allocated for the dairy character, ribs were given six points, thighs three points, withers four points, neck four points and skin three points .

3.2.1.3 Body Capacity

Barrel and Chest were the body parts judged for body capacity. Each of these was allocated five points.

3.2.1.4. Feet and Legs

Feet and legs were given fifteen points as per the scorecard. The score was distributed as five points for feet,four points for rear legs, three points for hocks and three points for pastern.

3.2.1.5. Udder

According to the scorecard, udder received more weightage, forty points were allocated for udder. For judging convenience the points were distributed as five points for udder depth, four points for teat placement, ten points for rear udder, four points for udder cleft, seven points for fore udder, four points for teats, two points for mammary veins and four points for udder balance and texture

3.4 MEASUREMENTS

The body measurements of individual animals were taken using a flexible steel tape calibrated in centimeters. The measurements were recorded when the animal was standing evenly on her feet with her neck elevated to apposition level with her back for the maximum precision (Bhakat *et al.*, 2008). The measurements were taken at the dorsal tops of skeletal structures in an attempt to reduce bias caused by variation of animal condition (Ali *et al.*, 1984).Care was taken to avoid any type of error.

3.4.1 Length

The length was taken as the distance on dorsal midline from the midpoint of the top of shoulder to a line connecting the prominences of the pins. The measurements were taken in the standing position with the legs positioned straight.

3.4.2 Heart girth

Chest girth is the circumference around the chest behind the withers (Anon, 2001). Each animal was restrained properly with the head held straight. The girth was taken using a fine rope and then using the measuring tape the measurement was noted.

3.4.3 Height at withers

The distance from the ground to the highest point of withers was taken as the height.

3.4.4 Length of quarter

The distance between the point of hip and point of pin was measured as the length of the quarter.

3.4.5 Width between angles of hip

Hip width was measured as the distance between the outer most points of the hips perpendicular to the back(Shanks and Spahr, 1982).

3.4.6 Slope of rump

Hip height and pin height were measured directly over hook bone and pin bone respectively, when the animal was standing squarely on four legs. The slope was calculated as the difference between height at pin bone and height at hook bone.

3.5 BODY WEIGHT

The body weight of each animal was calculated by the linear equation (Anon,2001),

Body Weight $=LG^2/300$,

where, L = length of the animal measured in inches

G = heart girth in inches.

The weight thus obtained in pounds was changed into kilograms by dividing by a factor 2.2.

3.6 DATA COLLECTION

The age, parity and stage of lactation records of animals under study were collected from the farm records.

3.6.1 Age, Parity and Stage of lactation

The age and parity of each animal was collected from the registers. The animals were categorized into four age groups, four parities and three stages of lactation. First age groups consisted of animals from age three to four. Second age group consisted of animals from age four to five. Animals of ages from five to six were considered in third age group and animals with six years of age and above were included in fourth. Stage of lactation was computed by subtracting the calving date from the date when the animals were judged and measured. First stage of lactation included animals up to first ninety days of lactation. Animals with lactation days from ninety to one hundred and eighty were considered to be in second stage of lactation. Animals above one hundred and eighty days of lactation were included in third stage of lactation.

3.6.2 Peak and total lactation milk yield

The milk yield and no of days in milking of each animal was obtained. The peak yield of each animal was noted from the daily records. The highest daily yield within 45 days of lactation was taken as the peak yield and the standard lactation was predicted due to animal variation in lactation length. Total lactation milk yield was calculated from the peak yield by multiplication with a ratio factor 215.5. (Anon, 2001

3.7 STATISTICAL ANALYSIS

The emphasis of each of the components of unified score card to milk production was compared and statistical analysis was carried out as per methods suggested by Snedcor and Cochran (1994).

Results

4. RESULT

4.1 JUDGING OF ANIMALS

The average scores for frame, dairy character, body capacity, feet & legs and udder as listed in the Table 4.1, were 12.39±0.07, 15.87 ± 0.09, 8.24±0.06, 12.21±0.09 and 31.0 ± 0.21 respectively. The plates from 1 to 24 depicted ideal and deviations of type components observed in the experimental units. The final score lied between 65.5 and 90.25 with an average of 79.32 ± 0.34.

4.1.1 Final score for different age groups, parities and stages of lactation

The average, minimum and maximum final scores for different age groups, parities and stages of lactation are shown in the Table 4.2. The average final scores for first, second, third and fourth age groups were 79.31 ± 0.97, 80.50 ± 0.79, 79.0 ± 0.62 and 79.32 ± 0.54. From the Figure1., it could be seen that third age group had both the lowest and highest final score. The average final scores were 78.61 ± 0.52, 80.17± 0.71, 81.33 ± 0.97 and 82.78 ± 1.67 for different parities. The lowest final score was for second parity and the highest for third parity as depicted in Figure 2. The average scores of animals of first second and third stage of lactation were 80.43±0.64, 80.98±0.83 and 80.76±0.91 respectively. Figure 3 depicts the minimum and maximum final scores for different stages of lactation. The maximum scores were almost equal for all stages of lactation. Age, parity and stage of lactation were found to be non significant for final score.

Table 4.1 Average, minimum and maximum scores for type components and final score

Type component	Average ±S.E	Range	
		Minimum	Maximum
Frame	12.39±0.07	8.75	14.5
Dairy character	15.86±0.09	13	18.5
Body capacity	8.24±0.06	6	9.5
Feet & legs	12.21±0.09	8.5	14.5
Udder	30.99±0.21	17.5	37.5
Final score	79.32±0.34	65.5	90.25

Table 4.2 Average, minimum and maximum final score for different age groups, parities and stages of lactation

Category	Groups	Average final score	Range	
			Minimum	Maximum
Age	1	79.31±0.97	67.25	83.75
	2	80.50±0.79	71.5	89.5
	3	79.0±0.62	65.5	90.25
	4	79.02±0.54	68	89.75
Parity	1	78.61±0.52	66	87.25
	2	80.17±0.71	65.5	87.75
	3	81.33±0.97	70.5	90.25
	4	82.78±1.67	72.5	89.75
Stage of lactation	1	80.43±0.64	65.5	90.25
	2	80.98±0.83	69.25	89.5
	3	80.76±0.91	66	88.5

Non significant

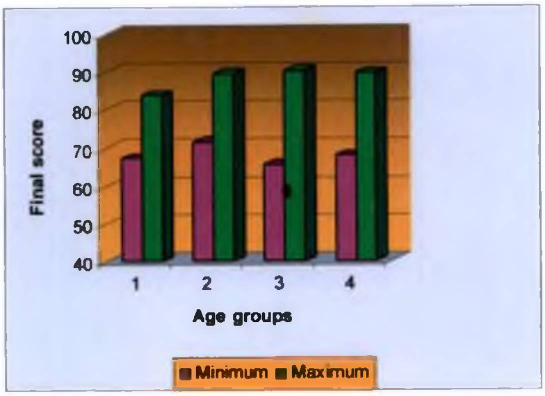

Figure 1- Minimum and maximum final score for different age groups

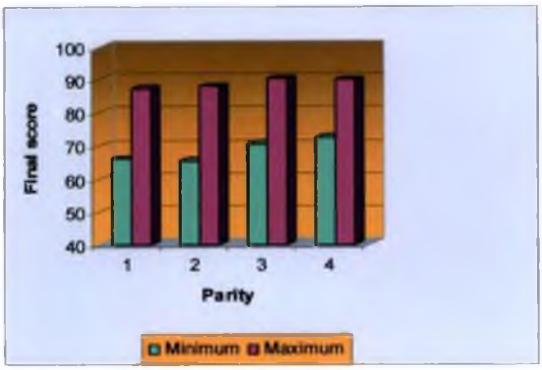

Figure 2- Minimum and maximum final score for different parities

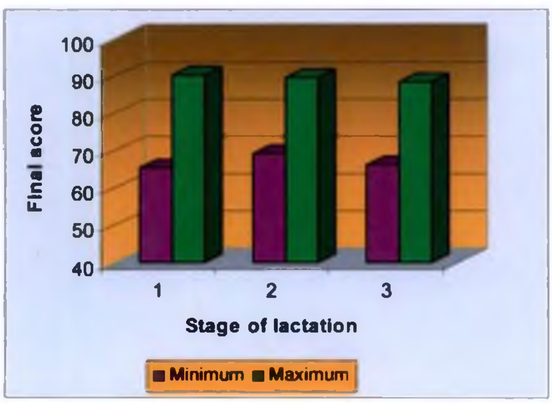

Figure 3- Minimum and maximum final score for different stages of lactation

4.1.2 Effect of age on type components

The mean scores of type components for different age groups are shown in Table 4.3. The scores of frame, dairy character and udder for different age groups showed no significant difference, whereas, scores of body capacity and feet and legs differed significantly ($p \leq 0.05$). The mean scores of body capacity for second (8.31±0.14), third (8.34±0.11) and fourth age group (8.35±0.09) was significantly higher from that of first age group (7.51±0.24). For feet and legs, the scores of first (12.60±0.27) and second age groups (12.72±0.22) were significantly higher that that of third (12.11±0.23) and fourth age groups (11.89±0.17).

4.1.3 Effect of parity on type components

The mean scores of type components for different parities are shown in Table 4.4. The scores of dairy character and body capacity differed significantly. No significant difference was shown for scores of frame, feet and legs and udder. The mean scores of body capacity were found to be having an increasing trend. The means scores of dairy character for fourth parity were significantly higher than those with lesser number of parities.

4.1.4 Effect of stage of lactation on type components

The mean scores for animals in different stages of lactation are presented in Table 4.5. None of the type components showed significant difference among different stages of lactation.

Table 4.3 Mean scores of type components for different age groups

Age Groups	Frame	Dairy character	Body capacity	Feet & legs	Udder
1	12.18 ± 0.21^{a}	15.66 ± 0.24^{a}	7.51 ± 0.24^{a}	12.60 ± 0.27^{a}	31.45 ± 0.61^{a}
2	12.33 ± 0.17^{a}	15.95 ± 0.19^{a}	8.31 ± 0.14^{b}	12.72 ± 0.22^{a}	31.34 ± 0.63^{a}
3	12.46 ± 0.13^{a}	15.99 ± 0.16^{a}	8.34 ± 0.11^{b}	12.11 ± 0.23^{b}	30.76 ± 0.52^{a}
4	12.47 ± 0.12^{a}	15.91 ± 0.14^{a}	8.35 ± 0.09^{b}	11.89 ± 0.17^{b}	30.86 ± 0.39^{a}

Mean values bearing different superscript in a column differ significantly ($p\leq0.05$)

Table 4.4 Mean scores of type components for different parities

Parity	Frame	Dairy character	Body capacity	Feet and legs	Udder
1	12.23±0.11 [a]	15.89±0.13 [a]	8.02±0.10 [a]	12.19±0.15 [a]	31.09±0.26 [a]
2	12.32±0.13 [a]	15.77±0.15 [a]	8.29±0.13 [ab]	12.15±0.10 [a]	30.96±0.38 [a]
3	12.77±0.13 [a]	15.75±0.23 [a]	8.61±0.18 [b]	12.36±0.21 [a]	30.86±0.63 [a]
4	12.80±0.30 [a]	16.55±0.25 [b]	8.50±0.33 [ab]	12.13±0.38 [a]	30.82±0.95 [a]

Mean values bearing different superscript in a column differ significantly ($p \leq 0.05$)

Table 4.5 Mean scores of type components for different stages of lactation

Stage of lactation	Frame	Dairy character	Body capacity	Feet and legs	Udder
1	12.36±0.09	15.94±0.16	8.33±0.12	12.54±0.18	31.01±0.40
2	12.31±0.13	16.19±0.21	8.39±0.15	12.68±0.23	30.96±0.54
3	12.59±0.18	16.09±0.23	8.13±0.16	12.58±0.26	31.58±0.58

Non significant ($p \geq 0.05$)

4.2 LACTATION YIELD.

The average lactation yield of all the experimental units together was found to be 2400.19± 43.32. The mean lactation yields for different age groups are furnished in Table 4.6 and depicted in Figure 4. The average yields were 2292.38 ±117.86, 2414.19 ±82.06, 2326.67±84.14 , 2483.57±71.87 for first, second, third and fourth age groups respectively. Age was found to be not significant for lactation yield ($p \geq 0.05$). The average lactation yields of animals in first, second, third and fourth parity as shown in Table 4.7 and Figure 5. were 2267.209±54.66, 2426.732±80.22, 2520.926±123.09 and 2719.610±130.33 respectively. The means of lactation yield differed significantly for different parities. The animals in fourth parity were found to have significantly higher lactation yield than those having lesser parities. Lactation yields of animals in first, second and third parity did not differ significantly.

4.3 CORRELATIONS OF TYPE COMPONENTS

The correlations of type component are furnished in Table 4.8. Frame was found to be positively correlated with other components, the least being with udder ($r=0.127$; $p>0.05$) and highest with feet and legs ($r=0.254$) which was highly significant($p<0.01$). Dairy character was significantly correlated with body capacity ($r=0.169$) and feet and legs ($r=0.254$) in addition to frame. Feet and legs was the only component to which udder showed positive significant correlation ($p<0.05$)

4.3.1 Correlations between type components and milk yield

All the type components were found to be positively correlated with lactation yield, all being significant. The highest correlation was for dairy character ($r=0.440$),

Table 4.6 Average lactation yield for different age groups

Category	Groups	Average lactation yield (kg)
Age	1	2292.38±117.86
	2	2414.19±82.06
	3	2326.67±84.14
	4	2483.57±71.87

Nonsignificant ($p \geq 0.05$)

Table 4.7 Average lactation yield for different parities

Category	Groups	Average lactation yield (kg)
Parity	1	2267.209±54.66 ^{a}
	2	2426.732±80.22 ^{ab}
	3	2520.926±123.09 ^{ab}
	4	2719.610±130.33 ^{b}

Mean values bearing different superscript in a column differ significantly ($p \leq 0.05$)

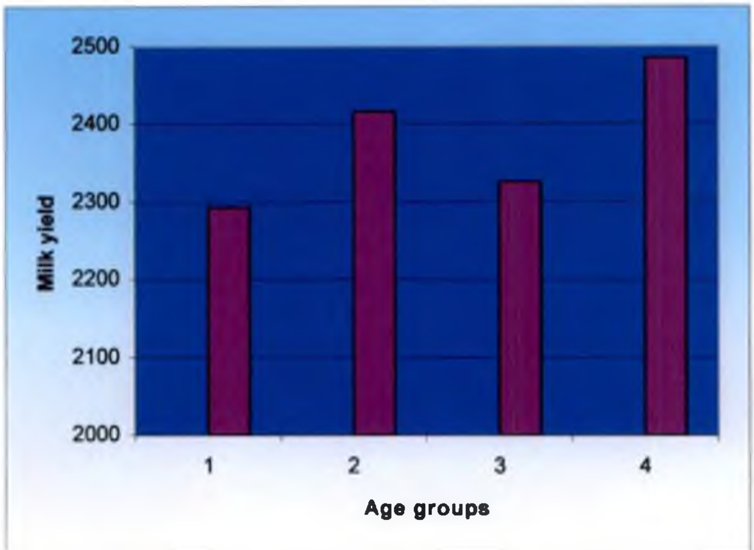

Figure 4- Average lactation yield in kg for different age groups

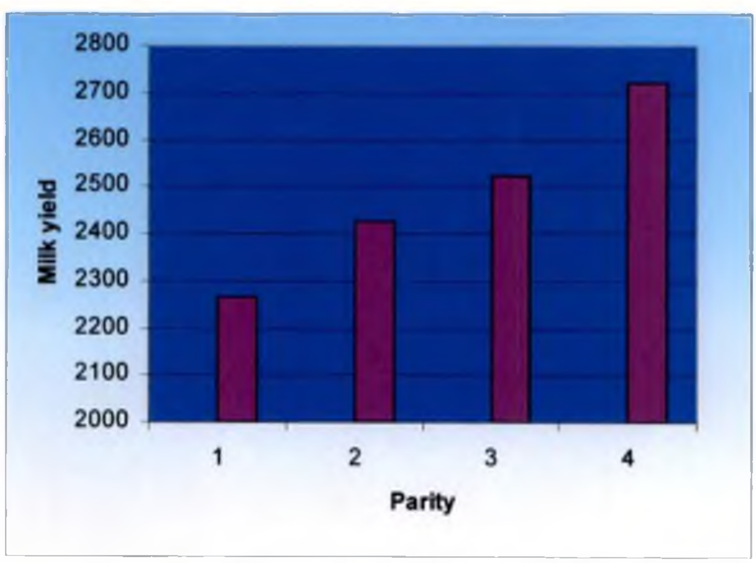

Figure 5- Average lactation yield in kg for different parities

Table 4.8 Correlations between major type components

Type component	Frame	Dairy character	Body capacity	Feet and legs	Udder
Frame	1.00	0.162*	0.245**	0.254**	0.127
Dairy character	_	1.00	0.169*	0.254**	0.115
Body capacity	_	_	1.00	-0.013	0.011
Feet and legs	_	_	_	1.00	0.183
Udder	_	_	_	_	1.00

**Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed)

followed by udder ($r=0.254$), body capacity ($r=0.241$), frame($r=0.170$) and feet &legs ($r=0.161$).The final score was also highly correlated with milk yield ($r=0.419$). The correlations between type components and milk yield has been presented in Table 4.9

4.3.2 Regression of type components on milk yield

The multiple linear regression analysis revealed the contribution of each type component towards milk production as presented in Table 4.10. The standardized partial regression coefficients were highly significant for dairy character, udder and body capacity. The standardized partial regression coefficients were found to be significant ($p \leq 0.05$) for dairy character, (0.378), udder (0.200), and body capacity, (0.166) whereas non significant regression coefficients were obtained for frame (0.037) and feet and legs (0.021).

4.3.3 Regression of traits under the type components on milk yield

The regression of traits under the type components on milk yield has been presented in Table 4.11. The R^2 was found to be 0.450 with a highly significant ($p<0.01$) F value. Udder depth was having the highest standardized partial regression coefficient ($\beta=0.312$) which was highly significant ($p<0.01$). Regression coefficients were significant ($p \leq 0.05$) and positive for skin (0.229), withers (0.188), ribs (0.174) and thighs (0.162). Stature, front end, neck, udder cleft, udder texture and balance, feet, and pasterns had nonsignificant negative regression coefficients for milk yield.

4.4 BODY MEASUREMENTS

The average, minimum and maximum body measurements are furnished in Table 4.12. The measurements for height at withers, length, chest girth, width between angles of hook, Length of quarter, height at hook, height at pins and slope were

125.91±0.42, 140.86±0.51, 162.14±0.38, 49.11±0.54, 45.71±0.42, 120.43±0.39, 115.18±0.37 and 5.25±0.17 respectively.

4.4.1 Effect of age on body measurements

The average measurements for different age groups are furnished in Table 4.13. Height at withers, length, hip width girth and height at hook showed significant difference with age ($p \leq 0.05$). The average heights of first, second, third and fourth age groups were 122.54±1.14, 126.17±1.08, 126.29±0.89 and 126.53±0.52 respectively. The average height of first age group was significantly lower than those of second, third and fourth as seen in Figure 6. The average body length of fourth age group (142.82±0.74) was significantly higher than those of first (136.0 ±1.36), second (139.09±99) and third age group (141.36±0.99) which is shown in Figure 7. The average girth and height at hooks of first age group were significantly different from other age groups as depicted in Figure 8. and Figure 9. respectively. The hip width of second and third age groups were significantly higher than first age group. The height at pins and slope were found to be not affected significantly by age.

4.4.2 Effect of parity on body measurements

The average measurements for different parities are presented in Table 4.14. The average height, length and girth of different parities have been shown in Figure 10, Figure 11. and Figure 12. respectively. The average heights of cows of first, second, third and fourth parity were 123.85±0.06, 127.44±0.73, 127.61±0.99, and 128.0±1.38 respectively. The average height of first age group was significantly different from second, third and fourth age groups. The average girth of first parity cows (160.70±0.63) were significantly different from second (163.10±0.62), third (163.34±0.72) and fourth parity cows(164.35±1.05).

Table 4.9 Correlations of major type components and final score with milk yield

Type component	r_p value
Frame	0.170*
Dairy character	0.440**
Body capacity	0.241**
Feet and legs	0.161*
Udder	0.254**
Final score	0.419**

**Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed)

Table 4.10 Regression of type components on milk yield

Variable	Standardised regression coefficient(β)	R^2
Frame	0.037	0.267
Dairy character	0.378**	
Body capacity	0.166**	
Feet and legs	0.021	
Udder	0.200**	

F=13.81(p<0.01)
**significant (p<0.01)

Table 4.11 Regression of traits under the type components on milk yield

Type component	Variable	Standardized regression coefficient(β)
Frame	Rump	0.102
	Stature	-0.068
	Front end	-0.154
	Back	0.033
	Head	0.078
Dairy character	Ribs	0.174*
	Thighs	0.162*
	Withers	0.188**
	Neck	-0.006
	Skin	0.229**
Body capacity	Barrel	0.088
	Chest	0.088
Feet & legs	Feet	-0.082
	Rear legs	0.109
	Hocks	0.024
	Pasterns	-0.113
Udder	Udder depth	0.312**
	Teat placement	0.039
	Rear udder	0.076
	Udder cleft	-0.075
	Fore udder	0.017
	Teats	0.038
	Mammary veins	0.082
	Udder balance & texture	-0.140

R^2=0.450; F = 5.794, ($p<0.01$)

** Significant at the 0.01 level
* Significant at the 0.05 level

Table 4.12 Average, minimum and maximum values of body measurements

Measurements(cm)	Mean±S.E	Minimum	Maximum
Height at withers	125.91±0.42	109	142
Length	140.86±0.51	118	154
Girth	162.14±0.38	146.5	171.5
Width	49.11±0.54	41	60.5
Length of Quarter	45.71±0.42	40	54
Height at hook	120.43±0.39	105	135
Height at pins	115.18±0.37	100	130
Slope	5.25±0.17	0.5	13

Table 4.13 Means of body measurements for different age groups

Measurements (cm)	Age groups			
	1	2	3	4
Height at withers	122.54±1.14 [a]	126.17±1.08 [b]	126.29±0.89 [b]	126.53±0.52 [b]
Length	136.0±1.36 [a]	139.09±99 [b]	141.36±0.99 [bc]	142.82±0.74 [c]
Hip width	45.89±0.63 [a]	48.85±0.59 [a b]	49.91±1.62 [b]	49.62±0.44 [b]
Girth	159.42±1.15 [a]	163.11±0.92 [b]	162.09±0.63 [b]	162.58±0.60 [b]
Length of quarter	44.04±0.43 [a]	44.61±0.41 [a]	46.48±1.28 [a]	46.15±0.35 [a]
Height at hook	118.58±1.19 [a]	121.54±1.03 [b]	120.71±0.74 [a b]	120.26±0.56 [a b]
Height at pin	113.50±1.06 [a]	115.81±0.89 [a]	115.61±0.73 [a]	115.05±0.54 [a]
Slope	5.17±0.54 [a]	5.74±0.42 [a]	5.07±0.38 [a]	5.19±0.27 [a]

Mean values bearing different superscript in a row differ significantly ($p \leq 0.05$)

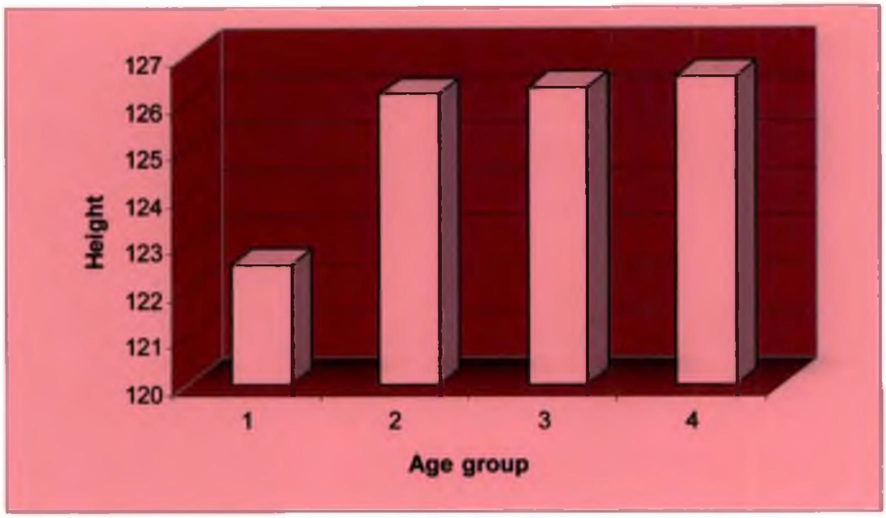

Figure 6- Average height in cm for different age groups

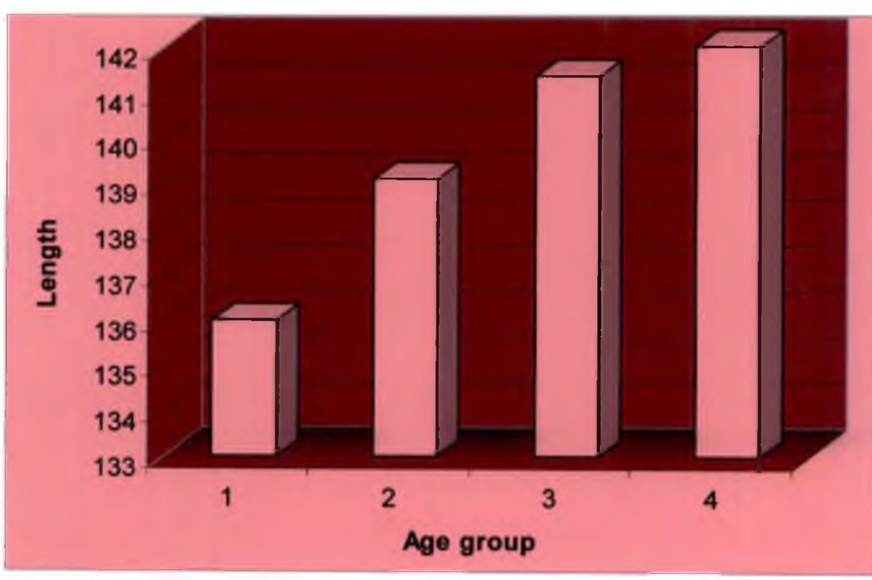

Figure 7- Average length in cm for different age groups

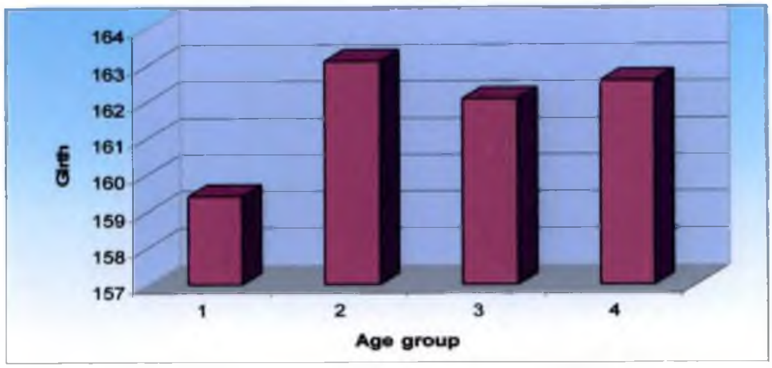

Figure 8- Average girth in cm for different age groups

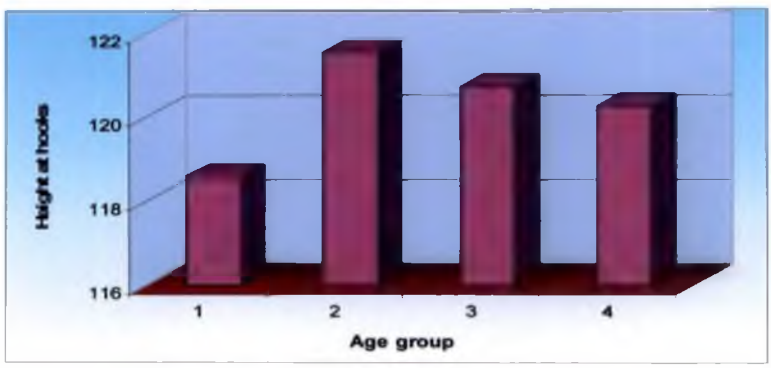

Figure 9- Average height at hooks for different age groups

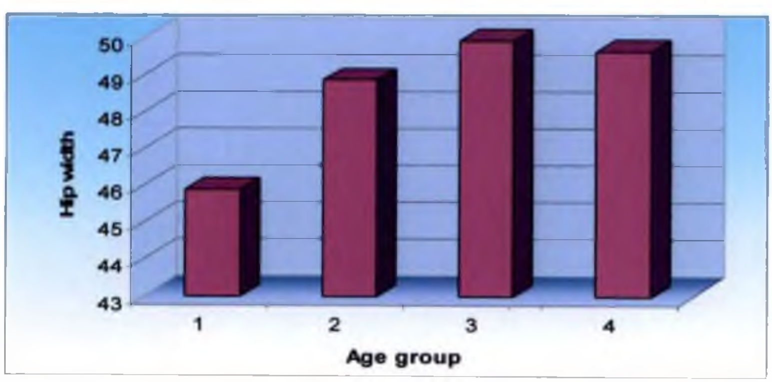

Figure 10- Average hip width for different age groups

Table 4.14 Means of body measurements for different parities

Measurements (cm)	Parity/Lactation			
	1	2	3	4
Height at withers	123.85±0.06[a]	127.44±0.73[b]	127.61±0.99[b]	128.0±1.38[b]
Length	138.64±0.73[a]	142.24±0.88[ab]	142.83±1.17[b]	144.50±1.71[b]
Hip width	48.01±1.10[a]	49.57±1.56[a]	50.43±0.63[a]	51.10±0.77[a]
Girth	160.70±0.63[a]	163.10±0.62[ab]	163.34±0.72[ab]	164.35±1.05[b]
Length of quarter	45.28±0.88[a]	45.52±0.39[a]	46.77±0.52[a]	46.67±0.66[a]
Height at hook	119.25±0.62[a]	121.11±0.63[a]	121.71±0.94[a]	121.75±1.157[a]
Height at pin	114.03±0.59[a]	116.11±0.59[a]	116.09±0.89[a]	116.0±1.54[a]
Slope	5.24±0.26[a]	5.0±0.29[a]	5.63±0.42[a]	5.65±0.62[a]

Mean values bearing different superscript in a row differ significantly ($p \leq 0.05$)

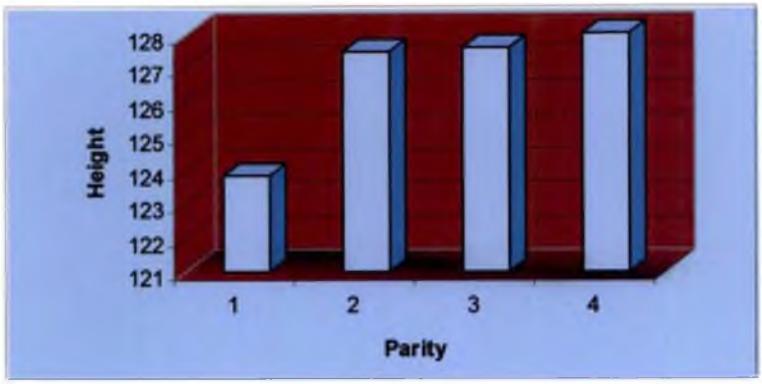

Figure 11 - Average height for different parities

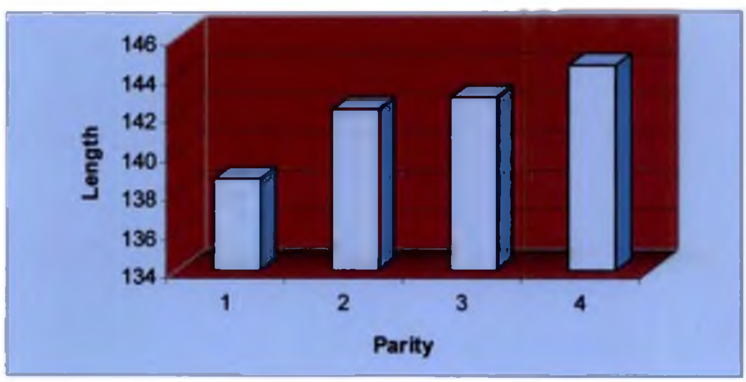

Figure 12- Average length in cm for different parities

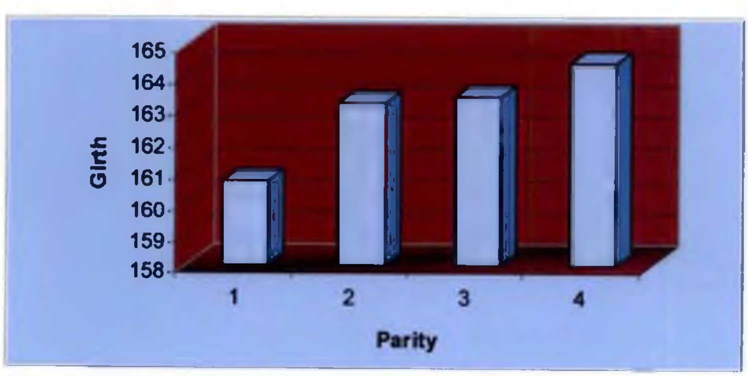

Figure 13- Average girth in cm for different parities

4.4.3 Correlations of type components and final score with measurements

The correlations of type components and final score with measurements are shown in Table 4.15. All the measurements except slope were significant and positive in correlation with body capacity. Height at withers, body length, girth, height at hooks and height at pins were found to be positively correlated with frame.($p<0.01$).Final score was having significant positive correlation with all height measurements($p<0.05$).

4.4.4 Correlations of measurements with milk yield.

All the height measurements and body length were found to be positively related to lactation yield. No significant correlation was shown between heart girth and milk yield.

4.5 BODY WEIGHT

The average body weight of the animals under the study was found to be 343.03 ±2.22. Both age and parity had significant positive correlation with body weight. Body weight was significantly ($p<0.01$) correlated with lactation yield with r=0.244

Table 4.15 Correlations of type components with measurements

Measurements (cm)	Frame	Dairy character	Body capacity	Feet & legs	Udder	Final score
Height at Withers	0.213**	-0.029	0.364**	0.006	0.127	0.173*
Length	0.170*	0.046	0.295**	-0.040	0.013	0.023
Girth	0.186**	-0.001	0.156*	-0.011	-0.023	0.129
Width	0.136	-0.028	0.270**	0.042	0.066	0.021
Length of Quarter	0.128	0.001	0.192**	-0.038	-0.004	0.057
Height at hook	0.234**	-0.068	0.282**	0.063	0.135	0.178*
Height at pins	0.265**	-0.089	0.319**	0.071	0.132	0.173*
Slope	-0.028	0.033	-0.044	-0.006	0.025	0.035

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed)

Plate 1. Ideal flat rump with minimum slope between rump and pins

Plate 2.Droopy rump with low lying pins

Plate3.Straight top line

Plate 4.Raised tail head

Plate 5.Good depth and spring of both fore and rear ribs

Plate 6. Shallow-ribbed animal with barrel shaped body

Plate 7. Adequate width at chest but toes turned out

Plate 8. Poor width at chest floor and between knees

Plate 9. Legs placed far apart

Plate 10.Closely placed legs with toes turned out

Plate 11. Ideal rear legs with optimum curvature at hocks

Plate 12.Ideal pastern with depth of heel and a level sole

Plate 13.a

Plate 13.b

Plate 13.a and 13.b. Sickle shaped legs with weak pasterns, and a shallow heel

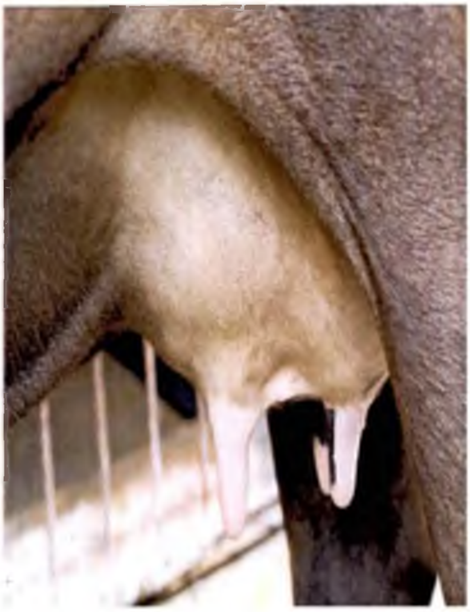

Plate 14.Ideal spacing of teats

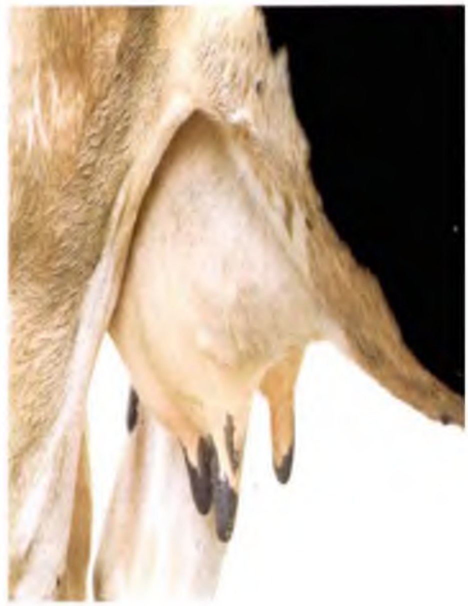

Plate 15.Closely placed teats

Plate 16.Funnel shaped teats

Plate17.Unsymmetrical and misshapen teats

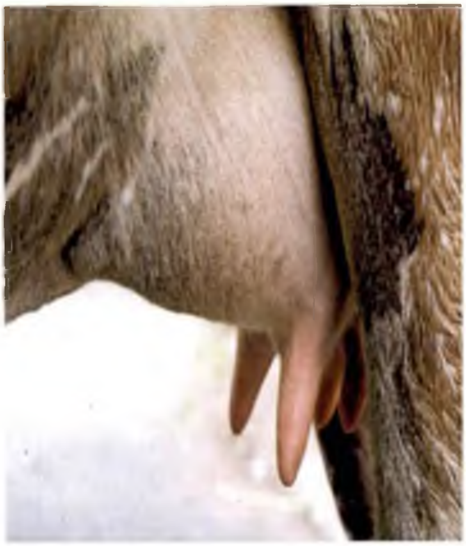

Plate18. Fore udder attachments optimum but tapering teats

Plate 19. Slightly tilted udder

Plate 20.Unequal sized teats

Plate 21.Teats lacking symmetry

Plate 22.Udder with plenty of room between the hocks, ideal cleft indicative of strong median suspensory ligament.

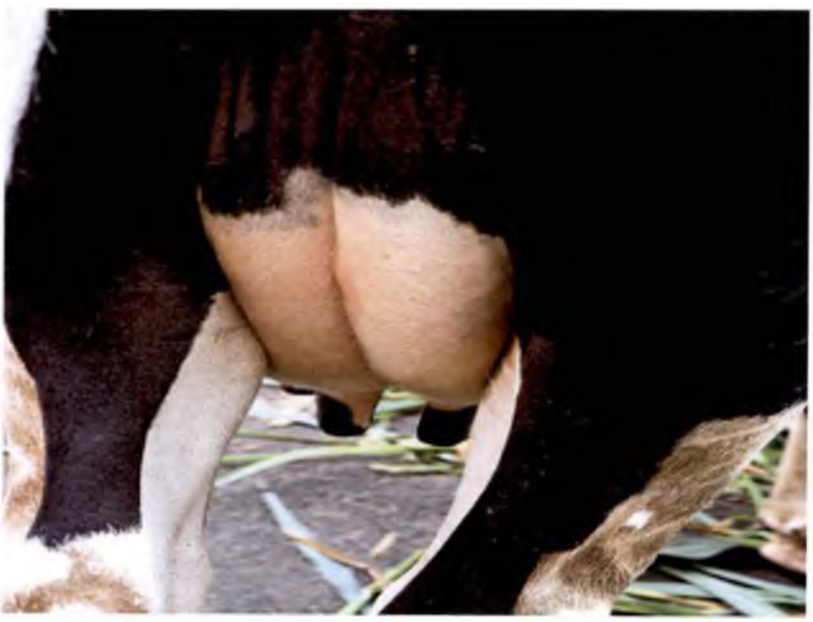

Plate 23.Good symmetry of udder but more pronounced udder cleft and inadequate udder tissue

Plate 24.a

Plate 24.b

Plate 24a.and 24b. Broken udder attachments and low lying udder

Discussion

5. DISCUSSION

5.1 JUDGING OF ANIMALS

The average scores for frame, dairy character, body capacity, feet and legs and udder as shown in Table 4.1 were all higher. The final score ranged from 65.5 and 90.25 with an average of 79.32 ± 0.34. The total averages indicated that majority of the animals under the present study were having almost good body conformation. Since some of the traits of the crossbred animals were not in exact agreement with those described in the PDCA score card (Appendix I) the final score obtained was comparatively low.

5.1.1 Final score for different age groups, parities and stages of lactation

The final scores for different age groups, parities and stages of lactation are shown in the Table 4.2. The data revealed that age, parity and stage of lactation were found to have no significant effect on the final score. As magnitude and direction, the components of final score differ with age, parity and stage of lactation, the nonsignificant effect could be justified. The final score might have decreased significantly with these parameters if the score had been independent and not a sum total of the type components or if the judging hade been done on same individual animals over different ages, parities and stages of lactation so that the gradual change could be detected so as to be reflected in the score.

5.1.2 Effect of age on type components

As presented in Table 4.3, the scores of frame, dairy character and udder for different age groups showed no significant difference, whereas, scores of body capacity and feet and legs differed significantly . Thompson *et al.*(1983) observed that age group was a significant ($p<0.01$) source of variation for all traits except rear legs (rear view) and heel depth. Strength of body and udder depth, which would be expected to change with age, exhibited the largest F-ratios for age. In the present study age group was found to have a significant effect on body capacity and feet and legs in contrary to his findings. The mean scores of body capacity for second, third and fourth age group was significantly higher from that of first age group. For feet and legs, the scores of first and second age groups were significantly higher than that of third and fourth age group. This might be due to the fact that most of the leg problems appeared as age advanced causing deterioration in the eye appeal on feet which caused a reduced score at older ages.

5.1.3 Effect of parity on type components

Foster *et al.* (1988) revealed that first parity cows were scored average for most traits but tended to be evaluated as slightly dairy and deep bodied, with shallow udders, relatively straight legs when viewed from the rear, udders with good cleft, and relatively fast milk out. As presented in Table 4.4, a supportive result was obtained to his finding. The scores of frame, dairy character and body capacity of cows in first parity differed significantly. The mean scores of body capacity were found to be having an increasing trend. The mean scores for dairy character of animals in fourth parity were significantly higher than those with lesser number of parities. No significant difference was shown for scores of frame, feet and legs and udder ($p\geq0.05$).

5.1.4 Effect of stage of lactation on type components

As per the present study, stage of lactation was found to have no significant effect on any of the type components. This observation was in contradiction to the results of Hansen *et al.*(1969), who found that stage of lactation had a significant effect ($p<0.01$) on final type score , general appearance , dairy character , body capacity and mammary system in their study on the effects of age and stage of lactation on type classification. No effect was seen for dairy character at different stages of lactation for animals under two years of age. At older ages, the effect of stage of lactation on dairy character became more pronounced with cows scoring lower during the latter part of lactation. However in the present study all the animals being below six years of age were not showing any significant difference in dairy character. This might be due to judging animals under different stages of lactation rather than judging a single individual animal at different stages of lactation. The experimental unit being a small one might have failed to project the change according to the production strategy. Moreover in crossbred the production capacity could not be competed with the exotic breeds. In high yielding animals, the change from a high production level at initial stages to lower levels at subsequent stages of lactation might be reflected in the body conformation, especially for mammary system which could not be expected in medium producing crossbred animals.

5.2 LACTATION YIELD.

5.2.1 Effect of age and parity on lactation yield

The average lactation yield was found to be 2400.19± 43.32. The animals of first age group and third age group were found to have lactation yields below the total average as furnished in Table 4.6 and depicted in Figure 4. Age was found to be not significant for lactation yield ($p\geq0.05$). . The means of lactation yield differed significantly for different parities which as seen in Table 4.7 and Figure 5. The animals having four parities were found to have significantly higher lactation yield than those having lesser parities. This result was in tone with the findings of Islam *et al.* (2006) who observed maximum yield recorded at fourth parity. Since milk yield was related to parity than age, and parity in turn need not be increased when age increased the result could be justified. Age was found to have no influence on milk yield whereas parity was significant on the lactation milk yield. The probable reason might be that parity was not increased as age increased due to delayed age at first parity and prolonged intercalving period.

5.3 CORRELATIONS AMONG TYPE COMPONENTS

The correlations of type components are furnished in Table 4.8. Foster *et al.* (1988) observed that basic form and strength of body were not highly correlated with any of the udder traits. Therefore selection on either basic form or strength of body would leave udder characteristics unaltered. The result derived from the present study wherein, except for feet and legs no other type component showed significant correlation with udder, was in agreement with his observation. Frame was found to be positively correlated with other components, except udder. Dairy character was significantly correlated with body capacity (r=0.169) and feet and legs (r=0.254) in addition to frame. In the same study, he observed large genetic correlations associated with traits in close proximity or traits that were similarly defined (i.e., basic form and strength). The basic form as indicated by the frame was found to be highly correlated with dairy character, which represented dairy strength. Ribs were a major trait considered under both dairy character and body capacity. Besides from the expected genetic correlations between both these type components, since ribs were a common major trait considered the correlations could be justified.

5.3.1 Correlations between type components and milk yield

A significant positive correlation (r=0.170) existed between frame and milk yield ($p<0.05$). This indicated that an animal could be trusted to be a good yielder as its general appearance announced. Gowen (1920) had commented general appearance of the cow as one of the conformational traits having a distinctly significant relation with milk production. As per the old dairy cow unified scorecard, general appearance was one of the traits and when revised it was substituted by frame .The animal was scored for its frame which took into account the overall appearance of the animal. The correlations was in full support to his findings.

As per the present study, among the type components, dairy character showed the highest significant correlation ($p<0.01$) with lactation milk yield (r=0.440). This observation was supported by Misztal *et al.* (1992) who found that among the type components dairy character had the largest genetic correlations with yield traits (r=0.59). Similar findings were observed by Short and Lawlor (1992) who reported that the linear traits with highest genetic correlation with milk production were dairy form (0.52).The study by Atkeson, (1969) revealed that ratings of dairy character were more closely related genetically and phenotypically with production and had shown more promise for use in selection. The present study also described dairy character on the scorecard as evidence of milking ability as shown by sharpness and openness since the animals scored high for dairy character were found to be good yielders as pointed out by the correlation.

The correlations of body capacity with other components and milk yield are shown in the Table 4.9. The correlations of body capacity with lactation yield was significant ($p<0.01$) and positive (r=0.241). Hoard (1999) commented that as ruminants and milk producers, cows needed to consume large volumes of forage and without adequate body capacity it would become difficult for cows to achieve high production levels. The current study also revealed the importance of body capacity to clear a way for high milk production. Even though the weightage as per the score card is less for body capacity, (ten points) its role was evident.

Significant positive correlation ($p<0.05$) was observed between feet & legs and milk yield ($r=0.161$). Perez-Cabal *et al.* (2006) observed that the cows that scored the highest for feet and legs, produced 575 kg more milk per year, and remained in the herd for 307 more functional days than the cows scoring the lowest. Feet and legs was the trait most genetically correlated to profit, although a low value (0.10) was obtained, whereas rear leg set was the trait most correlated to milk production (0.12). As per his study there is a positive correlation between lactation yield and scores of feet and legs. The present study goes in tone with his study , both results being strongly in contrary to the findings of Shapiro *et al.*(1991). According to him, no direct link appeared to exist between rear leg rear view and fertility or milk production, a low-scoring animal might have lower milk production because of reduced mobility. On multiple linear regression analysis, it was found that the contribution of feet and legs to milk production was the least ($\beta=0.021$) among the type components. This indicated that although there is a positive correlation, lactation yield may not be dependent on feet and legs, but on the other hand a bad conformation of feet and legs due to a lot many reasons can cause a negative effect on milk production.

The correlation of udder with milk yield ($r= 0.254$) was positive and highly significant($p<0.01$) as per the present study. Meyer *et al.*(1987) found that udder depth and fore udder attachment had largest antagonistic correlations with yield. In confliction to this observation, it was found that of the udder traits, udder depth was the one with highest regression coefficient of 0.312 which was highly significant ($p<0.01$) as shown in Table 4.10. According to Misztal *et al.* (1992), continued selection for milk yield would cause deterioration in some conformational traits. The udder traits would be those most affected. Selection to maintain udder depth would decrease progress for milk yield by about 15 %. The regression coefficient of the udder depth as per the present study was strongly against this antagonistic view. The results of Dahiya and Rathi, (2002) who found that most of the udder traits had medium to high phenotypic correlations with production efficiency was in conjunction with current result. The study by Rao *et al.* (2007) indicated that proper shape, size and measurements of the mammary gland significantly influence milk yield. The study gave a supporting hand to his finding by defining the proper shape, size and measurements of udder as a good scored udder and the influence on milk yield was estimated by correlation and regression anlaysis.

The study suggested that all type components were positively correlated with the milk yield . This indicated that the score card traits could be trusted to increase the accuracy of selection for milk production as they were closely related to milk production which supported the findings of Thomas and Sastry, (1991). Studies by Thomas and Sastry, (1991) and Misztal *et al.* (1992) revealed that the score card traits, were highly heritable. However the heritability could not be estimated in the present study since only one generation was involved. Studies on genetic correlations revealed that the type traits were positively correlated with milk yield (Berry *et al.* 2004). The correlations worked out by the present study could be explained on a genetic basis through their work.

5.3.2 Regression of type components and traits considered under them on milk yield

The multiple linear regression analysis revealed the contribution of each type component towards milk production as presented in Table 4.11. The regression coefficients were significant for dairy character, (β=0.378), udder(β=0.200), and body capacity, (β=0.166) whereas non significant regression coefficients were obtained for frame (β=0.037) and feet and legs(β=0.21).

The multiple linear regression of traits under the type components on milk yield has been presented in Table 4.10. The R^2 was found to be 0.450 with a highly significant ($p<0.01$) F value. In the present study udder depth was having the highest regression coefficient (β=0.312) which was highly significant ($p<0.01$). Regression coefficient were significant and positive for skin (0.229), withers (0.188), ribs (0.174) and thighs (0.162) which were all the traits considered under dairy character. Neck was the only trait under dairy character which showed a negative regression on milk yield. Stature, front end neck, udder cleft, udder texture and balance, feet, pasterns had negative nonsignificant regression coefficients for milk yield. This indicated that whether the features of these traits were in compliance with those as described in the score card, or not, it was not having any significance as far as milk yield was considered. The present result favoured a negative relationship between udder cleft and yield favouring the findings of Foster *et al.*(1989), at the same time conflicting with the negative relationship between udder depth and yield on contrary to his results.

5.4 BODY MEASUREMENTS

5.4.1 Effect of age and parity on body measurements

The average heights of cows of first, second, third and fourth age groups were 122.54±1.14, 126.17±1.08, 126.29±0.89 and 126.53±0.52 respectively. The average height of animals under first age group was significantly lower ($p\leq0.05$) than those of second third and fourth. The average body length of fourth age group (142.82±0.74) was significantly higher ($p\leq0.05$) than those of first (136.0 ±1.36), second (139.09±99) and third age group (141.36±0.99) . The mean girth and hook measurement of first age group were significantly different from other age groups. The hip width of second (48.85±0.59) and third age groups (49.91±1.62) were significantly higher($p \leq 0.05$) than first age group (45.89±0.63). These observations were in harmony with the result of Ali *et al.*(1984) who found that the effect of age of cow was significant ($p<0.05$) for all body characteristics. He observed that hip width, pin width, wither height, heart girth and thurl to pin increased with age. All other height characteristics increased with age up to five year and then started to decrease. In the current study all measurements except height at pins and slope, were found to be not affected significantly by age.

The average measurements for different parities are presented in Table 4.14. The average heights of cows of first, second, third and fourth parity were 123.85±0.06, 127.44±0.73, 127.61±0.99, and 128.0±1.38 respectively. The average height of first age group was significantly different from second, third and fourth age groups. The average height of cows in first parity (123.85±0.06) was significantly different from those in second (127.44±0.73), third (127.61±0.99) and fourth parities (128.0±1.38). The average length of cows in second (142.83±1.17) and third parity (144.50±1.71) were significantly higher than those in first parity (138.64±0.73). The average girth of first parity cows (160.70±0.63) were significantly different from second (163.10±0.62), third (163.34±0.72) and fourth parity cows(164.35±1.05). A significantly higher ($p \leq 0.05$) wither height, length and girth were found in cows in higher parities, in contrary to the findings of Enevoldsen and Kristensen, (1997) who observed a numerically lower mean height for cows in their third or greater lactation than younger cows.

5.4.2 Correlations of type components and final score with measurements

All height measurements, length and girth was found to be positively correlated with frame ($p<0.01$). All the measurements, except slope were significant and positive in correlation with body capacity..This observation was supported by the findings of Ali *et al.* (1984), that as in the case of simple correlations, capacity, size, and stature had the highest correlations with each of the height characteristics, heart girth, and rump compared with the other type traits. Since barrel and chest were the' body parts judged for body capacity a good barrel and chest will be reflected in the measurements of height and chest girth. The high correlations between height at pins and hooks however could be justified as he explained, that traits were genetically similar and that selection for one characteristic should improve the correlated one. Similar results were obtained by Vinson *et al.* (1982), where wither height, body length, chest girth, heights at hook and pin showed significant positive correlation with frame. From this it can be concluded that as observed by differences in linear scores seemed to identify conformational differences found by measurement.

5.4.3 Effect of body measurements on milk yield.

All the height measurements and body length were found to be positively related to lactation yield which similated results of Lin *et al.*(1987) who found that milk production traits were all positively correlated with body measurements, suggesting that high producing animals would be taller, larger, and longer than low producing ones. According to Sieber *et al.*(1988), taller cows tended to produce significantly more milk than shorter cows. Analyses of chest depth measurements showed a similar pattern to those for wither height, indicating that cows with deeper chests had higher milk yields. Despite of the correlation between height and yield similating his findings, cows with deeper chests were not found to have a significant increase of milk yield which was in controversy with the latter part of his result. The basis of the expectation that deeper chested animals have greater yields might be the increased chest space providing a good blood pumping and circulation. However, in the current study no correlation was obtained for girth and milk yield.

Wilk *et al.*(1963) concluded that body measurements were of little value in predicting milk production, but no basis was found for the often encountered claim of a genetic antagonism between measures of body size and milk production. The present study showed a significant positive correlation between measurements and milk yield irrespective of the claim of genetic antagonism between the same.

The present study aimed at assessing reliability of Unified score card in crossbred cows of Kerala, after the statistical analysis of all the observations and the reasoning thereafter, taking into account the past reviews came to a conclusion that the score card developed by Purebred dairy cattle association had reliability on the production of crossbred cows. But the emphasis placed on type components prescribed by the Purebred Dairy Cattle Association Dairy Cow Unified Score card was not in full agreement. The emphasis placed on these components was highest for udder (forty points) followed by dairy character (twenty points), frame and feet and legs (fifteen points each) and finally body capacity as per the Purebred Dairy Cattle Association Dairy Cow Unified Score card. In the present study, highest regression coefficient was for dairy character, followed by udder, body capacity, frame and finally feet and legs. Thus the result suggests that more weightage can be given to body capacity and dairy character compromising weightage on frame and feet & legs which necessitated further studies in this regard.

Summary

6. SUMMARY

The research work was conducted to assess the reliability of Unified score card on cross bred cows of Kerala. Animals under 6 years of age with at least one lactation were selected for the study. One hundred and ninety such animals of University cattle farms of Mannuthy, Thumburmuzhi and Thiruvazhamkunnu were thus included. As per the Unified score card by Purebred Dairy Cattle, the animals were judged for frame, dairy character, body capacity, feet and legs and udder. The type components were again subdivided as described in the scorecard to increase the accuracy of judging. The judging was done twice with an interval of one week to avoid bias on a particular day and the average score was taken as the actual score.

The body measurements of individual animals like height at withers, body length, chest girth, height at withers, height at pins, length of quarter, width between angles of hook and slope of rump were taken using a flexible steel tape calibrated in centimeters. The age and parity of each animal was collected from the registers. The animals were categorized into four age groups, four parities and three stages of lactation. First age group consisted of animals from age three to four. Second age group consisted of animals from age four to five. Animals of ages from five to six were considered as third age group and animals with six years of age and above were included in fourth. The number of days postcalving was computed by subtracting the calving date from the date when the animals were judged and measured. Animals having number of postcalving days upto first ninety days were included in first stage of lactation. Animals with lactation days from ninety to one hundred and eighty were considered to be in second stage of lactation. Animals

above one hundred and eighty days of lactation were included in third stage of lactation. The peak yield of each animals were noted from the daily records. The highest daily yield was taken as the peak yield and the standard lactation was predicted due to animal variation in lactation length .

The emphasis of each of the type components of unified score card on milk production was compared and statistical analysis was carried out as per methods suggested by Snedcor and Cochran (1994). Effects of age, stage of lactation and parity on judging using Unified Score Card were worked out. The body measurements were also correlated with the score and milk yield.

The average final scores for first, second, third and fourth age groups were 79.31 ± 0.97, 80.50 ± 0.79, 79.0 ± 0.62 and 79.32 ± 0.54. Third age group had the lowest and highest final score. The average final scores were 78.61 ± 0.52, 80.17± 0.71, 81.33 ± 0.97 and 82.78 ± 1.67 for different parities. The average scores of animals of first second and third stage of lactation were 80.43±0.64, 80.98±0.83 and 80.76±0.91 respectively. Age, parity and stage of lactation were found to be nonsignificant for final score. The scores of frame, dairy character and udder for different age groups showed no significant difference, whereas, scores of body capacity and feet and legs differed significantly. The mean scores of body capacity for second, third and fourth age group were significantly higher from that of first age group. For feet and legs, the scores of first and second age groups were significantly higher that of third and fourth age groups. The scores of dairy character and body capacity differed significantly with parity. No significant difference was shown for scores of frame, feet and legs and udder. The mean scores of body capacity were found to be having an increasing trend. The means scores for dairy character of animals of fourth parity were significantly higher than those with lesser number of parities. None of the type components showed significant difference among different stages of lactation.

Frame was found to be positively correlated with other components, the least being with udder (r=0.127) and highest with feet and legs (r =0.254) which was highly significant (p<0.01). Dairy character was significantly correlated with body capacity (r=0.169) and feet and legs (r=0.254) in addition to frame. Feet and legs was the only component to which udder showed positive significant correlation (p<0.05)

The average lactation yield of all the experimental units together was found to be 2400.19± 43.32. Age was found to be not significant for lactation yield (p≥0.05). The means of lactation yield differed significantly for different parities. The animals in fourth parity were found to have significantly higher lactation yield than those having lesser parities.

The magnitude and direction of type components on milk yield was found out by Karl Pearson correlation. The highest correlation was for dairy character (r=0.440), followed by udder (r=0.254), body capacity (r=0.241), frame(r=0.170) and feet &legs (r=0.161). All the type components were found to be positively correlated with lactation yield, all being significant. To assess the effect of each one on milk yield multiple linear regression analysis was carried out. The partial regression coefficients were significant for dairy character, (β =0.378), udder (β=0.200), and body capacity,(β =0.166) whereas, non significant regression coefficients were obtained for frame (β =0.037) and feet and leg (β =0.021). Multiple linear regression was carried out for traits under the type components also. Udder depth was having the highest regression coefficient (β=0.312) which was highly significant (P<0.01). Regression coefficient were significant and positive for skin (0.229), withers(0.188), ribs (0.174) and thighs(0.162). Stature, front end neck, udder cleft, udder texture and balance, feet, pasterns had nonsignificant regression coefficients for milk yield.

Height at withers, length, hip width girth and height at hook showed significant difference with age ($P \leq 0.05$).The height at pins and slope were found to be not affected significantly by age. The average heights of first age group was significantly lower than those of second, third and fourth age groups. The average body length of fourth age group (142.82±0.74) was significantly higher than those of first (136.0 ±1.36), second (139.09±99) and third age group (141.36±0.99).The average girth and height at hooks of first age group were significantly different from other age groups.

Height at withers, body length, chest girth, height at pins, and height at hooks were significant and positive in correlation with body capacity. The slope was found to have no significant correlation with body capacity. All height measurements, length and girth was found to be positively correlated with frame ($p<0.01$).Feet and legs and frame were nonsignificant in correlation with measurements. Final score was having significant positive correlation with all height measurements ($p<0.05$). The average body weight of the animals under the study was found to be 343.03 ±2.22. Both age and parity had significant positive correlation on body weight. Body weight was found to be significantly ($p<0.01$) correlated with lactation yield with $r=0.244$.

The study was concluded with the result that the score card was reliable on the crossbred cows of Kerala. The result suggested that more weightage can be given to body capacity and dairy character compromising weightage on frame and feet & legs which necessitates further studies in this regard.

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Appendix

APPENDIX-I

DAIRY COW UNIFIED SCORE CARD

MAJOR TRAIT DESCRIPTIONS

There are five major classification traits on which a classifier bases a cow's score. Each trait is broken down into body parts to be looked at and ranked.

1) Frame - 15%..15 points

The skeletal parts of the cow, with the exception of feet and legs, are evaluated. Listed in priority order, the descriptions of the traits to be considered are as follows:

Rump - long and wide throughout with pin bones slightly lower than hip bones. Thurls need to be wide apart and centrally placed between hip bones and pin bones. The tailhead is set slightly above and neatly between pin bones, and the tail is free from coarseness. The vulva is neatly vertical.

Stature - height, including length in the leg bones. A long bone pattern throughout the body structure is desirable. Height at the withers and hips should be relatively proportionate.
Front End - adequate constitution with front legs straight, wide apart and squarely placed. Shoulder blades and elbows need to be firmly set against the chest wall. The crops should have adequate fullness.
Back - straight and strong; the loin - broad, strong, and nearly level.
Breed Characteristics - overall style and balance. Head should be feminine, clean-cut, slightly dished with broad muzzle, large open nostrils and a strong jaw is desirable

2) Dairy Character - 20%..20 points

The physical evidence of milking ability is evaluated. Major consideration is given to general openness and angularity while maintaining strength, flatness of bone and freedom from coarseness. Consideration is given to stage of lactation. Listed in priority order, the descriptions of the traits to be considered are as follows:

Ribs - wide apart. Rib bones are wide, flat, deep, and slanted toward the rear.
Thighs - lean, incurving to flat, and wide apart from the rear.
Withers - sharp with the chine prominent.
Neck - long, lean, and blending smoothly into shoulders. A clean-cut throat, dewlap, and brisket are desirable.
Skin - thin, loose, and pliable.

3) Body Capacity - 10%.. 10 points

The volumetric measurement of the capacity of the cow (length x depth x width) is evaluated with age taken into consideration. Listed in priority order the descriptions of the traits to be considered are as follows:

Barrel - long, deep, and wide. Depth and spring of rib increase toward the rear with a deep flank.

Chest - deep and wide floor with well-sprung fore ribs blending into the shoulders.
The Barrel receives primary consideration when evaluating Body Capacity.

4) Feet and Legs - 15%..15 points

Feet and rear legs are evaluated. Evidence of mobility is given major consideration. Listed in priority order, the descriptions of the traits to be considered are as follows:

Feet - steep angle and deep heel with short, well -rounded closed toes

Rear Legs: **Rear View** - straight, wide apart with feet squarely placed.
Side View - a moderate set (angle) to the hock.

Hocks - cleanly molded, free from coarseness and puffiness with adequate flexibility.

Pasterns - short and strong with some flexibility.

Slightly more emphasis placed on Feet than on Rear Legs when evaluating this breakdown.

5) Udder - 40%...40 points

The udder traits are the most heavily weighted. Major consideration is given to the traits that contribute to high milk yield and a long productive life. Listed in priority order, the descriptions of the traits to be considered are as follows:

Udder Depth - moderate depth relative to the hock with adequate capacity and clearance. Consideration is given to lactation number and age.

Teat Placement - squarely placed under each quarter, plumb and properly spaced from side and rear views.

Read Udder - wide and high, firmly attached with uniform width from top to bottom and slightly rounded to udder floor.

Udder Cleft - evidence of a strong suspensory ligament indicated by adequately defined halving.

Fore Udder - firmly attached with moderate length and ample capacity.

Teats - cylindrical shape and uniform size with medium length and diameter.
Udder Balance and Texture - should exhibit an udder floor that is level as viewed from the side. Quarters should be evenly balanced; soft, pliable and well collapsed after milking.

TOTAL 100 Points

RELIABILITY OF UNIFIED SCORE CARD FOR CROSSBRED DAIRY COWS OF KERALA

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ABSTRACT

The research work was conducted to assess the reliability of Unified score card for cross bred cows of Kerala. One hundred and ninety six animals of University cattle farms of Mannuthy, Thumburmuzhi and Thiruvazhamkunnu were selected for the study. As per the Unified score card by Purebred Dairy Cattle Association, the animals were judged for frame, dairy character, body capacity, feet and legs and udder. The type components were again subdivided as described in the scorecard to improve the accuracy of judging score.

The body measurements of individual animals like height at withers, body length, chest girth, height at withers, height at pins, length of quarter, width between angles of hook and slope of rump were taken. The animals were categorized into four age groups, four parities and three stages of lactation. The emphasis of each of the components of unified score card to milk production was compared and statistical analysis was carried out as per methods suggested by Snedcor and Cochran (1994). Effects of age, stage of lactation and parity on judging using Unified Score Card were worked out. The body measurements were also correlated with the score and milk yield.

Age, parity and stage of lactation were found to be nonsignificant for final score. The scores of frame, dairy character and udder for different age groups showed no significant difference, whereas, scores of body capacity and feet and legs differed significantly . The scores of dairy character and body capacity differed significantly with parity. No significant difference was shown for scores of frame, feet and legs and udder. Frame was found to be positively correlated with other components, the least being with udder ($r=0.127$) and highest with feet and legs ($r=0.254$) which was highly significant ($p<0.01$). Dairy character was significantly correlated with body

capacity ($r=0.169$) and feet and legs($r=0.254$) in addition to frame. Feet and legs was the only component to which udder showed positive significant correlation ($p<0.05$).

Age was found to be not significant for lactation yield ($P \geq 0.05$). The means of lactation yield differed significantly for different parities. All the type components were found to be positively correlated with lactation yield, all being significant. The standardized partial regression coefficients were highly significant for dairy character, udder and body capacity whereas non significant regression coefficients were obtained for frame and feet and legs. Udder depth was having the highest regression coefficient ($\beta=0.312$) which was highly significant ($p<0.01$). Regression coefficients were significant and positive for skin (0.229), withers (0.188), ribs (0.174) and thighs (0.162). Both age and parity had significant positive correlation on body weight. Body weight was significantly ($p<0.01$) correlated with lactation yield with $r=0.244$. Height at withers, length, hip width girth and height at hook showed significant difference with age ($p \leq 0.05$).The height at pins and slope were found to be not affected significantly by age. All the measurements except slope were significant and positive in correlation with body capacity. All height measurements, length and girth was found to be positively correlated with frame ($p<0.01$). Final score was having significant positive correlation with all height measurements ($p \leq 0.05$).

It was concluded that although the score card was found to be reliable on the production of crossbred cows of Kerala, the emphasis placed on type components was not in full agreement with what was prescribed by the purebred Dairy Cattle Association Dairy Cow Unified Score Card. Hence it was suggested that more weightage could be given to body capacity and dairy character compromising weightage on frame and feet & legs which necessitated further studies in this regard.