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THE HERITABILITY ESTIMATES OF LINEAR TYPE TRAITS IN SAHIWAL COWS

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ABSTRACT

The present study was designed to get estimates of heritability for linear type traits of Sahiwal cattle. There were 790 observations on linear type traits of 310 cows scaled and scored at three stages of lactation. The cows were progeny of 53 sires with parity first to fifth. An animal model was fitted for estimation of variance component. Variance parameters were estimated using residual or restricted maximum likelihood (REML) procedures. The univariate animal model heritability estimates and standard errors were for stature 0.81±0.02, chest width 0.63±0.03, body depth 0.67±0.03, angularity 0.51±0.04, rump angle 0.52±0.04, rump width 0.78±0.02, rear legs set 0.72±0.02, rear legs rear view 0.76±0.02, foot angle 0.74±0.02, fore udder attachment 0.79±0.02, rear udder height 0.53±0.04, central ligament 0.77±0.02, udder depth 0.65±0.03, teat placement rear view 0.83±0.02, teat length (fore) 0.88±0.01, rear udder width 0.51±0.04, thurl width 0.62±0.03, navel length 0.93±0.01, dewlap width 0.73±0.02, dewlap surface area 0.59±0.03 and dewlap visual score 0.82±0.02. The heritability estimates obtained for linear type traits were in high range. These should be considered preliminary because of smaller data set. The estimates however indicated that a rapid change in desired direction is possible for most of the traits.

Key words: Sahiwal cattle, type traits, linear score, heritability estimates.

INTRODUCTION

Among the 450 tropical cattle breeds, zebu is the main type particularly in Indian and African subcontinent (Payne and Hodges, 1997). One of the best known Zebu breeds is the Sahiwal cattle in Pakistan (Javed *et al.*, 2000). It is considered to be one of the most productive of the *Bos indicus* species for tropical environments and has been suggested as model for developing dairy programs in less developed countries (Talbott, 1994). The breed has originated in the Gunji Bar (the area between river Ravi and Satluj) and main concentration of Sahiwal cattle is still in central and southern Districts of Punjab province (GOP, 2006). The main recorded population of Sahiwal cattle is found at Government livestock farms in public sector. The cows are recorded for productive and reproductive performance traits. However data on linear type traits is not recorded or maintained routinely. The selection is based mostly on gross milk yield or on the basis of EBV's for lactation yield. The bull calves are selected on the basis of milk yield of their dams (Bhatti *et al.*, 2007).

The recording of type traits is not common in Pakistan. The assignment of linear score for primary and secondary type traits for Sahiwal cattle has been demonstrated for the first time in Pakistan by Khan and Khan (2015). Recording a large number of type traits need a lot of financial input. Trained personals are needed to make such records accurately at farmer level. The information on heritability estimates and genetic correlations among linear type traits could help to devise simple selection indices and avoid complexity of including large number of traits.

The heritability estimates reported for different breeds are presented in Table 1 and Table 2. The heritability estimate for stature ranged from 0.27±0.23 for Sahiwal cattle in India (Dahiya, 2005) to as high as 0.59±0.07 for US Holstein (Thompson *et al.*, 1981), 0.59±0.01 for UK Holstein (Pryce *et al.*, 2000). The heritability estimate for chest width/strength ranged from 0.20 for Brown Swiss (Wiggans *et al.*, 2004 to 0.49±0.22 for Tharparkar cattle in India (Vij *et al.*, 1990). In some other studies the estimates for strength/chest width were 0.48±0.31 for Indian Sahiwal (Dahiya, 2005), 0.46±0.21 for Hariana (Dahiya, 2005), 0.41±0.09 for US Holstein (DeGroot *et al.*, 2002). The heritability estimates for dairy farm/angularity ranged from 0.17±0.03 for Friesian Holstein in UK (Meyer *et al.*, 1987) to 0.36±0.19 for Hariana (Dahiya, 2005). Other estimates for dairy farm/angularity in medium range were 0.36±0.09 for US Holstein (DeGroot *et al.*, 2002), 0.33±0.01 for UK Holstein (Pryce *et al.*, 2000). The heritability estimates were reported in low range for foot angle, rear legs set, rear legs rear view, fore udder attachment, rear udder height and rear udder width in many studies. However the estimates were higher for Hariana cows in study by (Dahiya, 2005) for foot angle 0.54±0.23, rear legs set 0.54±0.23, fore udder attachment 0.66±0.26, rear udder height 0.53±0.23 and rear udder width 0.54±0.23. Similar heritability estimates in higher range for rear udder height and rear udder width 0.54±0.36 and 0.63±0.37 were reported for Sahiwal cows in India (Dahiya, 2005). The heritability estimates for body depth ranged from 0.25 for Brown Swiss in USA (Wiggans *et al.*, 2004) to 0.48±0.06 for US Holstein (Thompson *et al.*, 1981). The higher heritability estimates for udder depth 0.60±0.23 in a smaller data set for Tharparkar cattle (Vij *et al.*, 1990) and 0.65±0.25 for 307 Hariana cattle (Dahiya, 2005) were reported. The heritability estimates for udder depth 0.40 was reported for Guernsey cows (Wiggans *et al.*, 2004). In more than a few other studies heritability estimates for udder cleft, front teat placement, rump width, rump angle and teat length were reported in low to medium range with a few exceptions. The high heritability estimate 0.65±0.25 was reported for udder cleft in Hariana cattle (Dahiya, 2005). The heritability estimates in medium range for front teat placement 0.43 for UK Holstein Friesian (Brotherstone, 1994), 0.44±0.04 for UK Friesian Holstein (Meyer *et al.*, 1987) and a high estimate 0.52±0.09 for US Holstein were reported (DeGroot *et al.*, 2002). The heritability estimates for rump width were in low to medium range for most studies except 0.81±0.29 for Hariana cattle in India for a small animal population (Dahiya, 2005). In a recent study the heritability estimates for linear type traits in low to medium range has been reported for Holstein cows in Brazil (Campos *et al.* 2012). The heritability for stature has been reported in medium range for Autochthonous Rendena Dual purpose breed of cattle (Mazza and Mantovani, 2012) and for linear type traits in Rendena dual purpose cattle in low to medium range (Mazza *et al.* 2014). The differences in heritability estimates for linear type traits for different breeds may be attributed to number of observations, the model used for estimation of parameters, the differences in definitions of the traits by different breed organizations and classifiers.

For tropical cattle breeds therefore studies on genetic control of type traits were very limited because such data sets are not available and more importantly, infrastructures to record and genetically select cattle for type traits do not exist especially under developing setups. Same was true for Sahiwal cattle breed in Pakistan. Such type of information is likely to be helpful for designing breeding strategies for genetic improvement programs. The genetic and phenotypic correlations among linear type traits for Sahiwal cattle for this same data set have been reported (Khan *et al.*, 2008). The present study has been designed to get the heritability estimates of linear type traits for Sahiwal cows in Pakistan.

Table 1. Heritability estimates for linear type traits reported for different breeds in different countries

Breed	Country	Number of observations.	Number of animals	Stature	Strength/ Chest width	Dairy form Angularity	Foot angle/foot shape	Rear leg set	Rear legs rear view	Fore udder attachment	Rear udder height	Rear udder width	References
Jersey	USA	34,999	22,354	0.41	0.28	0.26	0.13	0.14	-	0.24	0.33	0.27	Gengler *et al.* (1997)
Tharparkar	India	-	208	0.55±0.22	0.49±0.22	-	0.26±0.19	-	-	-	-	0.23±0.19	Vij *et al.* (1990)
Holsteins	USA	9,594	-	0.59±0.07	0.39±0.05	0.28±0.04	0.19±0.03	0.24±0.03	0.11±0.02	0.28±0.04	0.27±0.04	0.28±0.04	Thompson *et al.* (1981)
Milking Shorthorn	USA	-	-	0.75	0.7	0.19	0.16	0.07	-	0.24	0.11	0.25	Norman *et al.* (1983)
Guernsey	USA	-	12,996	0.53±0.06	0.26±0.04	0.25±0.04	0.09±0.02	0.12±0.03	-	0.12±0.03	0.28±0.04	0.21±0.04	Harris *et al.* (1992)
Friesian-Holstein	UK	-	13,192	0.55±0.06	0.34±0.04	0.17±0.03	0.19±0.03	0.16±0.03	0.12±0.03	0.27±0.04	-	0.25±0.04	Meyer *et al.* (1987)
Ayrshire	USA	-	-	0.54	0.31	0.20	0.15	0.15	-	0.21	0.26	0.19	Wiggans *et al.* (2004)
Brown Swiss	USA	-	-	0.43	0.20	0.18	0.13	0.18	-	0.22	0.22	0.19	Wiggans *et al.* (2004)
Guernsey	USA	-	-	0.49	0.22	0.28	0.10	0.16	-	0.29	0.28	0.28	Wiggans *et al.* (2004)
Jersey	USA	-	-	0.37	0.21	0.21	0.11	0.07	-	0.19	0.26	0.22	Wiggans *et al.* (2004)
Milking Shorthorn	USA	-	-	0.44	0.23	0.19	0.09	0.11	-	0.16	0.16	0.11	Wiggans *et al.* (2004)
Holsteins	USA	537961	-	0.43	0.25	0.26	0.14	0.17	-	0.22	0.22	0.17	Funk *et al.* (1991)
Guernsey	USA	12996	-	0.534±0.06	0.264±0.04	0.25±0.04	0.09±0.02	0.12±0.02	-	0.12±0.03	0.28±0.04	0.21±0.04	Harris *et al.* (1992)
Canadian Holstein	Canada	-	34322	0.48±0.04	0.23±0.02	-	-	0.20±0.02	-	0.18±0.02	-	-	Klassen *et al.* (1992)
Holstein-Friesian	UK	72559	-	0.48	0.27	0.26	-	0.19	-	0.27	-	-	Brotherstone (1994)
Holstein	France	-	12729	-	-	-	-	-	-	0.18±0.04	0.18±0.02	-	Rupp and Boichard (1999)
Holstein	UK	44674	-	0.59±0.01	0.39±0.02	0.33±0.01	0.16±0.01	0.19±0.01	-	0.19±0.01	0.23±0.01	-	Pryce *et al.* (2000)
Guernsey	USA	-	18725	0.48	0.30	0.27	0.12	0.13	-	0.19	0.23	0.23	Cruickshank *et al.* (2002)
Holstein Friesian	Iran	-	783	-	-	-	-	-	-	0.50	0.20	0.33	Sanjabi *et al.* (2002)
Holstein	USA	-	-	0.47±0.09	0.41±0.09	0.36±0.09	0.04±0.07	0.11±0.08	0.12±0.08	0.37±0.09	0.32±0.09	0.30±0.08	DeGroot *et al.* (2002)
Hariana	India	-	307	0.54±0.23	0.46±0.21	0.36±0.19	0.54±0.23	0.54±0.23	-	0.66±0.26	0.53±0.23	0.54±0.23	Dahiya (2005)
Sahiwal	India	-	208	0.27±0.23	0.48±0.31	0.31±0.23	0.13±0.31	0.35±0.28	-	0.33±0.28	0.54±0.36	0.63±0.37	Dahiya (2005)
Swiss-Holstein	Switzerland	-	140325	0.49±0.04	0.25±0.03	0.28±0.03	-	0.16±0.02	-	-	-	-	Neuenschwander *et al.* (2005)

Table 2. Heritability estimates for linear type traits in different countries.

Breed	Country	Number of observations.	Number of animals	Body depth	Udder depth	Udder cleft suspensory ligament	Front teat placement	Rump width hip width thurl width	Rump angle	Teat length	References
Tharparkar	India	-	208	-	0.60±0.23	-	-	-	-	-	Vij *et al.* (1990)
Holsteins	USA	9,594	-	0.48±0.06	0.27±0.04	0.20±0.03	0.19±0.03	0.25±0.04	0.27	-	Thompson *et al.* (1981)
HF	UK	72,559	-	0.35	0.39	0.16	0.43	0.22	0.29	0.44	Brotherstone (1994)
Frisian-Holstein	UK	-	18,939	0.42±0.04	0.29±0.03	0.20±0.03	0.44±0.04	0.21±0.03	0.33	0.26±0.03	Meyer *et al.* (1987)
Frisian-Holstein	UK	-	13,192	0.42±0.05	0.37±0.04	0.11±0.03	0.36±0.04	0.28±0.04		0.43±0.05	Meyer *et al.* (1987)
Jersey	Australia	-	-	-	-	0.36±0.08	0.31±0.07	-	-	-	Visscher and Goddard (1995)
Ayrshire	USA	-	-	0.29	0.31	0.23	0.24	0.35	0.28	0.30	Wiggans *et al.* (2004)
Brown Swiss	USA	-	-	0.25	0.34	0.22	0.27	0.18	0.27	0.34	Wiggans *et al.* (2004)
Guernsey	USA	-	-	0.32	0.40	0.21	0.31	0.29	0.41	0.34	Wiggans *et al.* (2004)
Holsteins	USA	-	-	0.34	0.27	0.14	0.21	0.31	0.30	-	Funk *et al.* (1991)
Holsteins	USA	-	-	0.34±0.02	0.25±0.02	0.13±0.01	0.22±0.02	0.24±0.02	0.29±0.02	0.26±0.02	Short *et al.* (1991)
Holstein	Spain	-	46316	0.32	0.24	0.24	-	-	-	-	Perez-Cabal and Alenda (2002)
Iranian Holstein Friesian		-	783	-	-	0.23	0.10		-	-	Sanjabi *et al.* (2002)
Holstein	USA	-	-	0.36±0.09	0.23±0.08	0.29±0.09	0.52±0.09	0.30±0.09	0.36±0.09	0.29±0.10	DeGroot *et al.* (2002)
Hariana	India	-	307	-	0.65±0.25	0.65±0.25	0.25±0.16	0.81±0.29	0.09±0.18	-	Dahiya (2005)
Sahiwal	India	-	-	-	0.35±0.29	0.53±0.31	0.27±0.23	0.82±0.33	0.07±0.27	-	Dahiya (2005)
Swiss Holstein	Switzerland	-	-	0.36±0.03	-	-	-	-	0.32±0.03	-	Neuenschwander *et al.* (2005)

MATERIALS AND METHODS

The Sahiwal cows calved at Livestock Experiment Station, Bahadurnagar, District Okara; Livestock Experiment Station, Jahangirabad, District Khanewal and Livestock Experiment Station, Khizerabad, District Sargodha during September 2005 to April 2006 were selected. The cows from parity first to fifth were scaled and scored for linear type traits on a linear score of 1-9 following the guidelines provided by International Committee on Animal Recording (ICAR, 2002). The fifteen linear type traits included stature, chest width, body depth, angularity, rump angle, rump width, rear legs set, rear legs rear view, foot angle, fore udder attachment, rear udder height, central ligament, udder depth, teat placement rear view and fore teat length. The rear udder width and thurl width are not recommended traits by the International Committee on Animal Recording. However some breed associations consider these traits. For the reason these were included in current study. The naval length (NL) and dewlap are traits of interest for Sahiwal cow breeders. The dewlap was characterized by measuring dewlap surface area (DSA) by leaf area machine and dewlap visual score (DVS) by observing the folds of dewlap. The assignment of linear score to all the type traits for Sahiwal cows has been described by (Khan and Khan, 2015). Linear scoring was performed at three stages of lactation in the start, at mid and towards end, provided cows remained in milk.

Information on birth and calving records and pedigree was collected from history sheets of cows maintained routinely at farms where a separate page has been allocated for each cow. The pedigree records were traced up to sires and dams of the animals. The final data set consisted of 790 observations for linear type traits on 310 cows, daughters of 53 sires. Distribution of observation is presented in table 3.

Table 3. Distribution of observations on linear type traits.

Effect	Level	Number of cows	Number of Observations
Herd	Bahadurnagar	127	331
	Jahangirabad	88	210
	Khizerabad	95	249
Parity	First parity	107	259
	Second and later parities	203	531
Stages of lactation	1 (15-45 days)	-	310
	2 (90-120 days)	-	262
	3 (165-195 days)	-	218

An animal model was utilized for estimation of variance component. The model included fixed effects of herd (three), parity group (two: 1^{st} and later) and stage of lactation (three: start, mid and end). The linear and quadratic effects of age at classification of cow and interaction effect of parity by stage of lactation were fitted in initial analysis but interaction effects were dropped from the final analyses as they were non-significant. The random animal effect was fitted and the all known relationships were accounted for. Variance parameters were estimated using residual or restricted maximum likelihood (REML) procedures developed by Patterson and Thompson (1971). The ASReml (Version 2.0) computer software was used for analysis (Gilmour *et al.* 2007).

The reduced statistical model fitted for estimation of heritability was as follows:

$$\mathbf{Y_{ijklm} = \mu + H_i + P_j + T_k + b_1(a_{ijkl}) + b_2\,(a_{ijkl})^2 + A_l + e_{ijklm}}$$

Where

μ = overall mean

H_i = effect of i^{th} herd (1-3)

P_j = effect of j^{th} parity group (1-2)

T_k = effect of k^{th} stage of lactation (1-3)

A_l = random animal effect

a_{ijklm} = age at classification with b_1 and b_2 were linear and quadratic regression coefficients of trait on age at classification

e_{ijklm} = random error

RESULTS

Heritability estimates for primary type traits: The additive genetic variance σ^2a, environmental variance σ^2e and univariate animal model heritability estimates and standard errors for linear type traits are presented in Table 4.

Table 4 Univariate animal model heritability (h^2) estimates and standard errors for linear type traits scored on a scale of 1-9

	Variances			
Traits	**σ^2a**	**σ^2e**	**h^2**	**SE**
Stature	2.8865	0.6566	0.81	0.02
Chest Width	1.0351	0.6125	0.63	0.03
Body Depth	1.7463	0.8680	0.67	0.03
Angularity	1.5021	1.4150	0.51	0.04
Rump Angle	1.2619	1.1533	0.52	0.04
Rump Width	1.5386	0.4401	0.78	0.02
Thurl Width	0.8424	0.5192	0.62	0.03
Rear Legs Set	1.9928	0.7666	0.72	0.02
Rear Legs Rear View	2.3058	0.7465	0.76	0.02
Foot Angle	2.4449	0.8597	0.74	0.02
Fore Udder Attachment	2.5065	0.6677	0.79	0.02
Rear Udder Height	1.7208	1.5351	0.53	0.04
Central Ligament	1.6167	0.4953	0.77	0.02
Udder Depth	1.3171	0.6991	0.65	0.03
Teat Placement Rear View	1.7213	0.3415	0.83	0.02
Teat length (Fore)	2.4121	0.3394	0.88	0.01
Rear Udder Width	1.1584	1.1259	0.51	0.04

In general the heritability estimates for most of the traits were in medium to high range. The heritability estimates ranged from 0.51±0.04 both for angularity and rear udder width to 0.88±0.01 for fore teat length. The heritability estimates were higher than 0.70 for rump width, rear legs set, rear legs rear view, foot angle, fore udder attachment and central ligament. The heritability estimates in medium to high range were for chest width 0.63±0.03, body depth 0.67±0.03, udder depth 0.65±0.03 and thurl width 0.62±0.03. The standard errors for linear type traits ranged from 0.02 to 0.04.

Heritability estimates for secondary type traits: The additive genetic variance σ^2a, environmental variance σ^2e and univariate animal model heritability estimates and standard errors for secondary type traits are presented in Table 5.

Table 5. Univariate animal model heritability estimates and standard errors for secondary type traits scored on a scale of 1-9.

	Variances			
Traits	**σ^2a**	**σ^2e**	**h^2**	**SE**
Naval Length	1.92769	0.1413	0.93	0.01
Dewlap Width	1.1482	0.4296	0.73	0.02
Dewlap Surface Area	1.6968	1.1793	0.59	0.03
Dewlap Visual Score†	0.4194	0.0948	0.82	0.02

†Scored on a scale 1-3

The heritability estimates for secondary type traits were in high range. The estimates were 0.93±0.01, 0.73±0.02, 0.59±0.03 and 0.82±0.02 for naval length, dewlap width, dewlap surface area and dewlap visual score.

DISCUSSION

In general, the heritability estimates obtained in current study were higher than reported in most of the studies for different dairy cattle breeds. One reason could be smaller data set precisely recorded in the selected farms in current study. Another big source of variation is the factor of classifier. Almost all of the breed associations of the world have their classifiers. So different classifiers may become source of variation resulting in increased environmental variance and hence have fewer estimates for additive genetic variance. This might be one of the reasons for low heritability estimates in many of the reported studies. The classifier as a source of variation has been highlighted by Vij *et al.*, (1990), Norman *et al.*, (1983). They have pointed out that classifiers introduce variation, resulting in increased environmental portion of variation and thus reducing additive variance resulting in poor heritability estimates. In present study classification was performed by one person that resulted in more uniform appraisal and higher estimates for additive variance.

It is fact that most of the populations have selective breeding programs with emphasis on sire of cow. As a result male genetic variance is smaller as compared to female genetic variance. Under such circumstances, sire model will underestimate genetic variability resulting in poor estimates for genetic parameters. This concept is supported by studies of Misztal (1990) and Vanraden *et al.* (1990). They pointed out that sire model ignore female's relationships, resulting in lower heritability estimates as compared to animal model. Even then many of the studies have reported heritability estimates in high range. The heritability estimate of stature 0.59±0.07 for US Holstein (Thompson *et al.*, 1981) and 0.59±0.01 for UK Holstein (Pryce *et al.*, 2000) and 0.53 for Autochthonous Rendena Dual purpose breed of cattle (Mazza and Mantovani, 2012), 0.52 for Rendena dual purpose cattle breed (Mazza *et al.* 2014) although in high range but were less than current study estimates.

The heritability estimates for chest width/strength 0.49±0.22 for Tharparkar cattle in India (Vij *et al.*, 1990) although slightly less than present study but are in high range with sire model. In some other studies the estimates for strength/chest width were 0.48±0.31 for Indian Sahiwal (Dahiya, 2005), 0.46±0.21 for Hariana (Dahiya, 2005) were also in higher range as for this study. Many of the studies have reported heritability estimates in low to medium range for body depth. However the heritability estimate 0.48±0.06 obtained from a large data set for US Holstein (Thompson *et al.*, 1981) was in high range as for the current study estimate.

The heritability estimates for dairy form/angularity in many of the studies are reported in low to medium range. Dairy form is assigned linear score visually and no subjective measurement is made. Hence portion of non-genetic variance is increased resulting in reduced additive genetic variance and hence reduced heritability estimates. In current study because of one classifier non-genetic variance is less and hence heritability estimates are high. Heritability estimates less than current study but in medium to high range were reported for Hariana cattle 0.36±0.19 (Dahiya, 2005), US Holstein 0.36±0.09 (DeGroot *et al.*, 2002) and UK Holstein 0.33±0.01 (Pryce *et al.*, 2000). The heritability estimates for rump width were in low to medium range for most studies except 0.81±0.29 for Hariana cattle in India is higher than current study estimate for a small animal population (Dahiya, 2005).

The heritability estimates were reported in low range for foot angle, rear legs set, rear legs rear view, fore udder attachment, rear udder height and rear udder width in many studies. The estimates less than current study but in higher range 0.54±0.23 both for foot angle and rear legs set, 0.66±0.26 very close to current study estimates for fore udder attachment, same as for this study 0.53±0.23 for rear udder width and slightly higher than current study estimate 0.54±0.23 for rear udder width has been reported for Hariana cows (Dahiya, 2005). Higher than current study estimates for rear udder height and rear udder width 0.54±0.36 and 0.63±0.37 were reported for Sahiwal cows in India (Dahiya, 2005). The heritability estimates in high range for udder depth 0.60±0.23 for 208 Tharparkar cattle (Vij *et al.*, 1990) and 0.65±0.25 for 307 Hariana cattle (Dahiya, 2005) were not very different from current study estimates. Although less than current study but in medium range the heritability estimate for udder depth 0.40 was reported for Guernsey cows (Wiggans *et al.*, 2004).

The high heritability estimate 0.65±0.25 for udder cleft in Hariana cattle (Dahiya, 2005), 0.65 for central ligament (udder cleft) in Turkish Holstein (Tapki and Guzey 2013) were not very different from current study estimates.

Lower than current study the heritability estimates in medium range for front teat placement 0.43 for UK Holstein Friesian (Brotherstone, 1994), 0.44±0.04 for UK Friesian Holstein (Meyer *et al.*, 1987) and a high estimate 0.52±0.09 for US Holstein were reported (DeGroot *et al.*, 2002). It is proposed that linear score recording be initiated at Government farms as well as in the field at farmer level to have big data set. That will help to have even more authentic estimates of genetic parameters. This information could be used for devising genetic improvement programs for Sahiwal cattle.

Conclusions: The heritability estimates obtained for linear type traits were in high range. These should be considered preliminary because of smaller data set. The estimates however indicated that a rapid change in desired direction is possible for most of the traits. Conformation recording in Sahiwal cattle should be started for making more information available on linear type traits and to have more reliable estimates of genetic parameters.

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