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Genetic studies on production and reproduction traits of Ongole cattle at organized farms

ASHWANI KUMAR[1], UMESH SINGH[2], RAJBIR SINGH[3] and R VINOO[4]

Sardar Vallabahbhai Patel University of Agricultural and Technology, Modipuram, Uttar Pradesh 250 110 India

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The Ongole cattle breed, also known as Nellore, was developed in the deltas of the rivers Penna, Krishna and Godawari, on the east coast of Peninsular areas. The population of Ongole has declined in recent past and the purity of breed has degraded. Ongole cattle were used in their native place for both work and milk production. The animals of this breed have also earned good gratitude for heat tolerance, hardiness, capacity to thrive on scanty dry fodder and good performance on tropical pasture. Looking into the importance and demand of the breed, a genetic improvement program through progeny testing was executed to improve the productive performance of the breed. The knowledge of genetic and non-genetic factors on the reproduction traits is important information which may enable animal breeders to practice selection and culling. Therefore, the present investigation was undertaken on Ongole cattle with the objectives to assess the effect of genetic and non-genetic factors for production and reproduction traits, which would help in selection for genetic improvement of the breed.

Data were collected from Livestock Research Station (LRS), Lam, Guntur; Government Cattle Breeding Farm (GCBF), Chadalwada; Government Livestock Farm (GLF), Chintaldevi; and Livestock Research Station (LRS), Mahanandi. The genetic improvement program through progeny tesing is being executed at Livestock Research Station, Lam Farm, Guntur of Shri Venkateswara Veterinary University Tirupati (Andhra Pradesh) in collaboration with the Central Institute for Research on Cattle (ICAR), Meerut. Calf weight at birth record (3,070) and production and reproduction records (2,900) of 729 Ongole cows belonging to 67 sires over period of 25 years from 1985–2009 were collected. The data were classified according to period of birth/calving 1985–90, 1991–96, 1997–2002, 2003–2009. Each year of birth/calving was further devided into 3 seasons i.e. Nov-Feb, Mar-Jun and Jul-Oct. The traits were considered calf weight at birth (CW), lactation milk yield (LMY), peak yield (PY), lactation length (LL), age at first calving (AFC), service period (SP), dry period (DP) and calving interval (CI). The data were analyzed separately using LSMLMW – PC Package (Harvey 1990). The model for production and reproduction characteristics incorporated set, farm, season and period of calving as fixed effects and sire/set as a random effect. These were used in the model for analysis of calf weight. The following model was used for analysis

$$Y_{ijklmno} = m + F_i + SR_{ij} + P_k + S_l + L_m + SE_n + e_{ijklmno}$$

Where, $Y_{ijklmno}$ observation on production/reproduction trait; m, over all mean; F_i, fixed effect due to ith farm; SR_{ij}, random effect due to jth sire under ith farm; P_k, fixed effect due to kth period of birth/calving; S_l, fixed effect due to lth season of birth/calving; L_m, fixed effect due to mth lactation number; SE_n, fixed effect due to nth set of sire and $e_{ijklmno}$, random residual error.

Calf weight was 26.09±0.36 kg (Table 1). It was in confirmation with the report of Singh *et al.* (2004) and Kumar *et al.* (2002) in Ongole cows. Prabhukumar *et al.* (1991) reported higher calf weight than the present study. The set and season of birth had no significant effect on calf weight. The effect of farm, period of birth, sex and parity on calf weight was significant. The calf weight was the lowest at GLF Chintaldevi and highest at LSR Mahanandi. Lowest calf weight was found in P1 (1985–1990) and highest in P4 (2003–2009). The calf weight was higher in male and lower in female.

Lactation milk yield (Table 1) was in accordance with the report of Vinoo *et al.* (2005), Kumar *et al.* (2003). Set of sires, farm, and parity had significant effect on lactation milk yield, while period and season of calving had no significant effect. Lactation milk yield was the lowest in set 5 and highest in set. The significant effect of set on lactation milk yield also observed by the Singh *et al.* (2008). The lowest lactation milk yield was found at LRS Lam Guntur and the highest at GLF Chintaldevi. Singh *et al.* (2008) also observed significant effect of farm on lactation milk yield in Ongole cows. Period had no significant effect on lactation milk yield in present study. However, Kumar *et al.* (2003), Chakravarthy *et al.* (2002) in Ongole cows

Present address: [1]M.V.Sc. Scholar (ashwanik465@gmail.com), [2]Principal Scientist (usinghas@gmail.com), ICAR-Central Institute for Research on Cattle, Grass Farm Road, Meerut. [3,4]Professor (rajbirsinghsvbp@gmail.com), (vinoo31 @yahoo.com), Livestock Research Station, Lam Farm, Guntur.

observed significant effect of period of calving on lactation milk yield. Season had no significant effect on lactation milk yield. The similar effect was found by the Vinoo *et al.* (2005) and Singh *et al.* (2004). The lactation milk yield was the lowest in first parity and highest in eighth parity. Chakravarthy *et al.* (2002) were observed almost similar effect of parity. The average of peak yield was 3.98±0.14 kg (Table 1) and was in accordance with the reports of Singh *et al.* (2008). Sreemannarayana and Rao (1988) reported higher peak yield than the present study. The farm, period of calving, season of calving, parity had significant effect whereas, set of sires had no significant effect on peak yield. Peak yield was highest at GLF Chintaldevi and lowest at GCBF Chadalwada. The highest peak yield was in P2 (1991–1996) and lowest in P3 (1997–2002). Similar effect was found by Singh *et al.* (2008), Chakravarthy *et al.* (2002) in Ongole cows. Significant seasonal variation in peak yield was in agreement with the report of Singh *et al.* (2004) and Chakravarthy *et al.* (2002) in Ongole cows. The peak yield was the highest in S1 (winter) and lowest in S2 (summer). Peak yield improved from first parity to eighth parity and decline thereafter reaching to the level of 4.13±0.27 kg in 11th parity. Chakravarthy *et al.* (2002) also observed significant effect of parity on peak yield. Lactation length was 225.78±9.70 days (Table 1). Sreemannarayana *et al.* (1996) in Black Ongole cows reported longer lactation length as compared to our findings. Lactation length of Ongole cows affected significantly by set of sires, farm and parity. Period and season of calving had no significant effect on lactation length. The lactation length was the longest in set 2 and the shortest in set 5. Singh *et al.* (2004) also observed significant effect of set of sires on lactation length. The lactation length was the shortest at LRS Farm Lam Guntur and the longest at GCBF Chadalwada. Similar effect

Table 1. Least squares means of calf weight, lactation milk yield, peak yield and lactation length

Factor	Calf weight (kg)		Record	Mean±SE		
	n	Mean±SE		LMY (kg)	PY (kg)	LL (days)
μ	3070	26.09±0.36	2900	678.84±43.11	3.98±0.14	225.78±9.70
Set				*		**
1	830	26.29±0.22	787	740.46±26.79	4.15±0.09	236.34±6.14
2	828	26.41±0.26	792	728.80±30.08	4.13±0.16	238.22±6.93
3	552	26.55±0.40	528	696.36±46.61	4.06±0.15	232.25±10.51
4	738	25.92±0.55	680	639.71±61.33	3.86±0.26	216.13±13.74
5	122	25.29±0.46	113	588.88±48.24	3.71±0.16	205.94±11.49
Farm		**		**	**	**
LRS Lam Guntur	1515	26.55±0.36	1474	481.31±42.87	3.82±0.14	173.51±9.64
LRS Mahanandi	563	27.33±0.38	480	617.24±45.69	3.96±0.15	205.59±10.42
GCBF Chadalwada	573	25.30±0.40	547	579.07±45.57	3.13±0.15	264.63±10.39
GLF Chintaldevi	419	25.18±0.40	399	1037.70±45.3	5.02±0.15	259.37±10.43
Period of calving		*			**	
P1 (1985 – 1990)	106	25.17±0.53	42	670.47±63.60	3.91±0.22	243.28±15.23
P2 (1991 – 1996)	555	26.36±0.39	458	714.73±45.08	4.17±0.15	224.03±10.25
P3 (1997 – 2002)	1270	26.30±0.37	1193	676.87±42.68	3.85±0.14	222.53±9.58
P4 (2003 – 2009)	1139	26.53±0.36	1207	653.29±42.21	4.00±0.14	213.27±9.45
Season of calving					*	
S1 (Nov-Feb)	1059	26.03±0.37	1012	767.66±43.79	4.64±0.14	224.54±9.86
S2 (Mar-Jun)	1153	26.01±0.37	1086	667.30±43.79	3.92±0.14	223.88±9.89
S3 (Jul-Oct)	858	26.23±0.37	802	692.57±43.66	3.99±0.14	228.91±9.86
Sex		**				
Male	1588	26.83±0.37	-	-	-	-
Female	1482	25.35±0.37	-	-	-	-
Parity		**		**	**	**
1	849	24.62±0.35	762	555.37±41.79	3.38±0.13	209.62±9.33
2	624	25.33±0.36	594	646.48±42.41	3.67±0.14	223.16±9.51
3	466	25.70±0.36	454	653.75±43.09	3.77±0.14	223.76±9.70
4	363	26.08±0.37	345	677.08±43.95	3.89±0.14	227.71±9.94
5	266	25.88±0.39	257	690.76±44.97	3.93±0.15	231.04±10.22
6	181	26.50±0.41	177	706.25±46.66	3.99±0.15	230.18±10.69
7	133	26.19±0.43	129	693.14±48.87	4.03±0.16	229.32±11.30
8	82	26.41±0.48	80	757.78±92.91	4.33±0.18	234.96±12.39
9	54	27.22±0.54	54	689.11±57.22	4.30±0.19	216.39±13.54
10	32	26.92±0.63	30	702.52±66.07	4.38±0.23	226.10±15.88
11	20	26.92±0.75	18	695.01±78.25	4.13±0.27	231.31±19.05

*P<0.05; **P<0.01.

of farm on lactation length was found by Singh *et al.* (2008) and Vinoo *et al.* (2005) in Ongole cows. Period of calving had no significant effect on lactation length in the present investigation. However, Singh *et al.* (2008), Vinoo *et al.* (2005), Kumar *et al.* (2003) and Chakravarthy *et al.* (2002) observed significant effect of period on lactation length. Lactation length was the shortest in first parity and longest in eighth parity. Significant effect of parity on lactation length was confirmed Chakravarthy *et al.* (2002).

The age at first calving was 1459.01±28.99 (Table 2). Singh *et al.* (2008) and Vinoo *et al.* (2005) reported longer age at first calving. It was differed significantly across the set of sires, farm, period of birth, season of birth. The shortest age at first calving was at set 5 and longest at set 1 . Similar effect of set of sires on age at first calving was observed by Singh *et al.* (2004) in Ongole cows. The result on significant effect of farm on age at first calving corroborated with Singh *et al.* (2008) and Vinoo *et al.* (2005) in Ongole cow. The age at first calving was the longest at GLF Chintaldevi and the shortest at LRS Lam Guntur. The age at first calving was the longest during P4 (2003–2009) and shortest during P1 (1985–1990). Significant effect of period of birth on age at first calving was also observed by Singh *et al.* (2008), Vinoo *et al.* (2005), Kumar *et al.* (2003) and Chakravarthy *et al.* (2002) in Ongole. The age at first calving was the longest in rainy season and shortest in summer. However, Singh *et al.* (2008) did not find similar results according to the present study. The means service period was 261.26±26.15 days (Table 2) and was in accordance with the report of Vinoo *et al.* (2005), Singh *et al.* (2004) and Acharya and Bhat (1989) in Ongole cows. Farm and parity had significant effect on service period, whereas set of sires, period and season of calving had no significant effect on service period. Service period was the

Table 2. Least square means of age at first calving, service period, dry period and calving interval

Factor	Age at first calving			Mean±SE(days)		
	Record	Mean±SE(days)	Record	Service period	Dry period	Calving interval
µ	729	1459.01±28.99	2278	261.26±26.15	347.91±26.87	555.71±23.93
Set		**				**
1	139	1581.50±31.24	671	262.42±15.37	328.66±15.82	553.31±14.28
2	155	1492.76±45.70	662	285.91±25.74	359.81±26.43	582.35±23.37
3	126	1486.57±47.61	401	259.49±26.44	337.61±27.18	551.80±24.26
4	220	1375.64±59.92	510	246.40±34.15	337.92±35.08	526.53±31.14
5	89	1358.61±56.16	34	252.10±35.87	376.14±37.15	564.84±35.00
Farm		**		**	**	**
LRS, Lam Guntur	343	1234.14±30.92	1250	102.99±25.83	226.85±26.54	394.08±23.58
LRS, Mahanandi	84	1362.69±39.90	415	276.05±27.78	397.97±28.58	567.45±25.69
GCBF, Chadalwada	163	1569.92±34.07	414	328.87±27.99	366.42±28.80	627.50±25.92
GLF, Chintaldevi	139	1659.31±34.32	199	337.15±28.81	400.39±29.66	634.03±26.81
Period of calving		**				
P1 (1985 – 1990)	26	1145.13±90.57	48	243.01±36.87	343.31±38.10	542.50±35.33
P2 (1991 – 1996)	170	1412.72±42.38	447	260.06±27.50	342.49±28.29	552.52±25.40
P3 (1997 – 2002)	279	1595.65±39.64	1001	278.74±26.16	356.51±26.88	572.50±23.94
P4(2003 – 2009)	254	1682.57±41.78	782	263.24±25.81	349.31±26.51	555.55±23.56
Season of calving		**				
S1 (Nov-Feb)	256	1445.52±31.50	811	258.90±26.63	346.30±27.21	550.99±24.83
S2 (Mar-Jun)	306	1431.22±30.56	826	263.43±26.63	350.85±27.37	558.65±24.45
S3 (Jul-Oct)	167	1500.31±32.28	641	261.46±25.54	346.58±27.28	557.66±24.35
Parity				**	**	**
1	-	-	639	318.65±25.02	417.48±25.68	610.32±22.69
2	-	-	470	275.91±25.45	355.61±26.14	566.98±23.17
3	-	-	353	263.16±25.98	342.03±26.69	554.01±23.74
4	-	-	268	241.12±26.46	326.16±27.20	539.72±24.27
5	-	-	187	244.17±27.34	320.00±28.12	537.16±25.22
6	-	-	145	250.95±28.23	336.02±29.05	548.74±26.18
7	-	-	84	280.46±30.73	356.18±31.67	580.70±28.85
8	-	-	60	254.12±32.77	336.71±33.81	551.90±31.02
9	-	-	40	270.30±35.86	374.74±37.04	562.94±34.27
10	-	-	22	238.89±41.82	326.82±43.26	529.54±40.46
11	-	-	10	236.17±55.51	335.21±57.52	531.41±54.48

*P<0.05; **P<0.01.

shortest at LRS Farm, Lam and longest at GLF Farm, Chintaldevi. Vinoo *et al.* (2005) and Singh *et al.* (2004) also reported significant effect of farm on service period. The shortest service period (236.17±55.51 days) was in 11th parity and longest service period (318.65±25.02) in first parity. Vinoo *et al.* (2005), Singh *et al* (2004), Kumar *et al.* (2003) and Chakravarthy *et al.* (2002) also observed significant effect of parity on service period. The overall mean of dry period was 347.91±26.87 days (Table 2). Kumar *et al.* (2003), Chakravarthy *et al.* (2002) and Sreemannarayana and Rao (1988) in Ongole cows reported shorter dry period as compared to present study. Farm and parity had significant effect on dry period, while set of sires, period and season of calving had no significant effect on dry period. Dry period was the shortest at LRS, Lam, Guntur and longest at GLF, Chintaldevi. Vinoo *et al.* (2005), Singh *et al.* (2004) and Chakravarthy *et al.* (2002) in Ongole cows also reported no significant effect on season of calving on dry period. Dry period was shortest in fifth parity and longest in first parity in Ongole cows. Calving interval in Ongole cows was 555.71±23.93 days (Table 2). However, Kumar *et al.* (2003) and Chakravarthy *et al.* (2002) found shorter calving interval. It was affected by set of sires, farm and parity. Calving interval was found shortest in set 4 and longest in set 2. Similar effect of set of sires was found by Singh *et al.* (2004). Shortest calving interval was found at LRS, Lam Guntur and longest at GLF, Chintaldevi. The result on significant effect of farm on calving interval corroborated with Vinoo *et al.* (2005) and Singh *et al.* (2004) in Ongole cows. Calving interval was the shortest in 10th parity and longest in first parity.

Calf weight had low heritability estimate in the present study. The heritability of lactation milk yield was low with low standard error. Low heritability was also found by Singh *et al.* (2008) and Vinoo *et al.* (2005) in Ongole cows for lactation milk yield. The heritability estimate for peak yield along with standard error was 0.14±0.03. Lactation length had low heritability estimate. However, Singh *et al.* (2008) and Vinoo *et al.* (2005) cows reported medium heritability estimate of lactation length. The heritability estimate of age at first calving was medium (0.50±0.13). Vinoo *et al.* (2005) reported higher heritability estimate in Ongole cows. Singh *et al.* (2004) reported lower heritability estimate of age at first calving than the present study. The heritability estimate for service period was 0.16±0.04. The result reflected that the service period at the farms may further be improved successfully by improving feeding and management including heat detection, artificial insemination and pregnancy diagnosis. Singh *et al.* (2008) and Vinoo *et al.* (2005) also reported similar heritability for service period. Dry period had low heritability estimate (0.15±0.04). Vinoo *et al.* (2005) reported little higher heritability estimate for dry period in Ongole cows than the present study .Heritability of calving interval was low (0.12±0.04). Singh *et al.* (2008) and Vinoo *et al.* (2005) in Ongole cows also found higher heritability estimate of calving interval than the present study.

Lactation milk yield had high genetic and high phenotypic correlation with peak yield and lactation length (Table 3), Singh *et al.* (2008). Similar relationships between lactation milk yield and lactation length were reported, Vinoo *et al.* (2005). Peak yield had medium genetic and phenotypic correlation with lactation length. Singh *et al.* (2004) also found high genetic and phenotypic correlation between peak yield and lactation length in Ongole cows. High genetic correlation was found between service period and dry period in Ongole cows, Vinoo *et al.* (2005). Very high genetic correlation was found between service period and calving interval in the present study. Similar relationship was also found by Vinoo *et al.* (2005) and Singh *et al.* (2004) in Ongole cows. Dry period had high genetic correlation with calving interval. Similar relationships were also found by Vinoo *et al.* (2005) and Singh *et al.* (2004). Service period had high phenotypic correlation with dry period. However, Vinoo *et al.* (2005) did not find similar relationship between service period and dry period in Ongole cows. Very high phenotypic correlation was found between service period and calving interval. However, Vinoo *et al.* (2005) found medium phenotypic correlation between service period and calving interval. Dry period also had high phenotypic correlation with calving interval. However, Vinoo *et al.* (2005) found medium phenotypic correlation between dry period and calving interval in Ongole cows.

SUMMARY

The study was undertaken to assess the genetic and non genetic factors affecting the productive and reproductive performance of Ongole cattle. Record (3,070) of calf weight and lactation records (2,900) of 729 Ongole cows, maintained at livestock farms (LRS, Lam, Guntur; LRS, Mahanandi; GCBF, Chadalwada; and GLF, Chintaldevi) in Andhra Pradesh, daughter of 67 bulls during 25 years from 1985 to 2009 were used in the analysis. The male calves were heavier than female calves. Low heritability estimated for lactation milk yield and reproductive traits indicated that there is less additive genetic variance in these traits and individual selection will not be helpful for improving them. Also, high genetic correlation between lactation milk yield and peak yield indicated that selection for peak yield may bring reasonable genetic improvement in milk yield of Ongole cows. The results also revealed there is a further scope for improvement in milk production and reproductive performance of the animals through better feeding and management practices.

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