SELECTION OF SUMBA ONGOLE (SO) CATTLE BASED ON BREEDING VALUE AND PERFORMANCE TEST

S. Said[1], P. P. Agung[1], W. P. B. Putra[1], S. Anwar[1], A. S. Wulandari[1] and A. Sudiro[2]

[1]*Laboratory of Animal Reproduction, Breeding and Cell Culture,*
Indonesian Institute of Sciences,
Jln. Raya Jakarta-Bogor Km. 46 Cibinong, Bogor, Jawa Barat 16911-Indonesia
[2]*PT. Karya Anugerah Rumpin*
Jln. Raya Cibodas No. 99 Rumpin, Bogor, Jawa Barat 16350
Corresponding E-mail: syahruddinsaid01@gmail.com

ABSTRAK

Seleksi pada ternak bertujuan untuk meningkatkan produktivitas. Sebanyak 50 ekor sapi Sumba Ongole (SO) terdiri dari 25 jantan dan 25 betina digunakan untuk uji performan. Uji performan pada sapi dilakukan pada tiga periode (2014, 2015 dan 2016) selama $\pm$535 hari. Data rekording berat badan dianalisis secara deskriptif dengan program komputer Microsoft Office Excel 2007. Sapi dengan umur 300 sampai 600 hari dipilih untuk program uji performan. Hasil penelitian menunjukkan bahwa nilai heritabilitas berat setahunan (YW_{365}) sebesar 0,77$\pm$0,68 dan termasuk kategori tinggi. Nilai pemuliaan YW_{365} tertinggi sebesar 66,05 kg (jantan) dan 41,89 kg (betina). Rata-rata berat akhir terkoreksi (BAT) terhadap rerata umur sebesar 391,52$\pm$51,88 kg (jantan) dan 318,29$\pm$51,53 kg (betina). Hasil uji performan pada penelitian ini diperoleh enam ekor sapi kelas A (1 jantan dan 5 betina) yang memiliki kriteria sesuai dengan standar minimum ukuran tubuh pada sapi SO.

Kata kunci: Sumba Ongole, berat umur setahun, heritabilitas, nilai pemuliaan, uji performan

ABSTRACT

Selection of livestock was purposed to increase productivity. A performance test was conducted using 25 males and 25 females of Sumba Ongole (SO) cattle. The performance test were conducted in three periods (2014, 2015 and 2016) for about 535 days. Descriptive statistics ws used to analyze data of body weight. Cattle with age between 300 to 600 days were used for evaluation. Result showed that heritability value of yearling weight (YW_{365}) was 0.77$\pm$0.68 as a high category. The highest breeding value of YW_{365} were 66.05 kg (male) and 41.89 kg (female). The average of corrected final weight (CFW) weight were 172.55$\pm$34.22 kg (male) and 159.80$\pm$37.73 kg (female). The performance test in this study obtained six A class (1 bull and 5 cows) based on the standard minimum of body measurements for SO cattle.

Key words: Sumba Ongole, yearling weight, heritability, breeding value, performance test

INTRODUCTION

Sumba Ongole (SO) cattle is one of Indonesian indigenous cattle that live in Sumba Island (Nusa Tenggara Timur Province). The SO cattle was imported from India since 1906 by Dutch colonial government (Hardjosubroto, 1994). This cattle was *Bos indicus* and adapted

well at tropical climate and this breed potential as a beef cattle in Indonesia. Agung *et al.* (2015) reported that the average of hot carcass weight of male SO cattle (slaughters weight 626 kg to 650 kg) was 358.06±15.35 kg. Meanwhile, Hendro (2010) reported that the average body weight and hot carcass weight of male SO cattle (2.5 to 3.0 years age) at 90 days of fattening reached 444.90±6.64 kg and 243.60±3.13 kg, respectively. Priyanto *et al.* (2015) reported that pH, water holding capacity, tenderness, cooking loss, and marbling score of male SO cattle meat (18 to 30 months of age) are 5.50±0.07; 29.09±1.61% mg H_2O; 7.55±0.64 kg/cm^2; 46.79±3.06 %; and 2.00±0.26; respectively..

Selection for genetic improvement in SO cattle can be reached through progeny test and performance test (Hardjosubroto, 1994). The progeny test was used for bull selection based on offspring performance. Therefore, selection of bull and heifer could be conducted by using the breeding value (BV) information (Falconer and Mackay, 1996). Cattle with highest BV score is the best livestock among their herd. Most of breeding centre in the world using body weight (birth, weaning, yearling weights) and body measurements (withers height, body length, heart girth) as the criteria of livestock selection. Several study showed that yearling weight at 365 days of age (YW_{365}) are used as selection criteria in Bali (Supriyantono *et al.,* 2010), Ongole grade/PO (Prihandini *et al.,* 2011), Bhagnari x Droughtmaster (Khan *et al.,* 1998), Hanwoo (Park *et al.,* 2013) and Nelore cow (Mercadante *et al.,* 2003). The selected bull and heifer must be continued to the performance test as the last selection step in beef cattle (Rodriguez and Guerra*,* 2013). Patmawati *et al.* (2013) reported that the performance test for 9 months) in Bali bull (1 to 2 years age) obtained body weight of 261.56±81.20 kg, withers height of 17.61±6.40 cm, body length of 123.08±10.07 cm and heart girth of 156.89±15.15 cm.

As a local cattle, study of selection system in SO cattle at the breeding station is very important to obtain the best bull and cow. The selected bull from the selection program can be used for producing semen through libido and sperm quality tests. Therefore, the semen can be used for genetic improvement of cattle, especially in Sumba Island. The aim of this study was conducted to select the best SO bull and heifer based on performance test during 2014 to 2016 at the breeding station.

MATERIALS AND METHODS

Research Site and Animals

This research was conducted at private breeding station (PT. Karya Anugerah Rumpin) in Rumpin district, Bogor Regency, West Java Province. The station is situated at latitude 06°28'50.3'' S and longitude 106°39'03.0'' E about 3500 to 4000 m above the sea level. The humidity 70% to 80% with temperature 28°C to 30°C and rainfall occuring ±2,500 mm/year. Records data of body weight from sixty SO cattle (year 2012 to 2016) were used in the study.

Animals Management

The animals were devided into two groups based on sex at the colony stall. Three periods of performance test were conducted in this study (Table 1). Cattle with 300 to 600 days of age with individual breeding value (BV) of yearling weight at 365 days of age were used for evaluation. Cattle were adapted to a ration for two month before the test. The ration consisted of Elephant grass (*Pennisetum purpureum*), rice straw and cassava meal. They were fed the ration *ad libitum* 60% and 40% of the energy approximately were provided by silage and concentrate, respectively. The nutrient compostion for SO cattle at the breeding station presented in Table 2.

Animal Measurements

The cattle were weighed and measured every month since birth to final age using digital weight scale and calipers respectively. The WH was measured with a stick-ruler as the distance from the surface of the platform to the dorsal point (*Os vertebrae thoracalis III*) of the withers. The BL was measured using a tape from the distance between the point of the shoulder (*Tuber humerus* on *Os humerus*) and the pinbone (*Tuber ischiadicum* on *Os coxa*). The HG was measured using a tape measure as circumference of the chest just behind the foreleg (*Os costa V*). The SC was measured using a tape measure as circumference of the scrotum.

Data Analysis

Data Correction. Data of birth, weaning and yearling weights were corrected based on Hardjosubroto (1994):

$$CF_{Sex} = \frac{BW_{Male}}{BW_{Female}}$$

Table 1. The Performance Test Schedule for SO Cattle at Breeding Station

Period	Group	N	Date of Testing		Duration (days)
			Start	Finish	
I	Bull	13	10 September 2012	13 May 2014	609
	Cow	10	20 May 2013	24 May 2014	369
II	Bull	5	2 February 2014	29 July 2015	542
	Cow	7	15 February 2014	12 May 2015	451
III	Bull	7	25 December 2014	21 March 2016	452
	Cow	8	29 January 2015	24 March 2016	785

N: numbert of animal

Where

CF_{Sex} : correction factor of sex (only used for female animal)

WW_{205} : corrected weaning weight (kg) at 205 days of age

YW_{365} : corrected yearling weight (kg) at 365 days of age

BW : birth weight (kg)

WW : actual weaning weight (kg)

W : weight when measured (kg)

T_1 : interval time (days) between birth to weaning measurement

T_2 : interval time (days) between weaning to measurement

Heritability. Estimation of heritability value was calculated using analysis of variance (ANOVA) method with Patternal Halfshib Correlation model refering to Becker (1992):

$$h^2 = 4t$$

$$t = \frac{Var_{(S)}}{Var_{(S)} + Var_{(w)}}$$

$$SE\left(h^2\right) = 4\sqrt{\frac{2(1 - t)^2 [1 + (k - 1)(t)]^2}{k(k - 1)(S - 1)}}$$

$$k = \frac{1}{S - 1}\left(N - \frac{\sum n_i^2}{N} \right)$$

Where

h^2 : heritability

$Var_{(S)}$: variance of sire

$Var_{(W)}$: variance of individu

$Cov_{(S)}$: covariance of sire

SE : standard error

k : constanta

S : number of sire

N : total of progeny

n_i : number of progeny per sire

Breeding value. Estimation of breeding value (BV) for each animal was conducted to yearling weight (YW_{365}) and calculated based on Hardjosubroto (1994):

$$BV = h^2 \left(P_{Ind.} - P_{Pop} \right) + P_{Pop}$$

Where

BV : breeding value

h^2 : heritability

P_{Ind} : individual growth trait

P_{Pop} : average of growth trait in population

Performance test. Records data of body weight were analysed descriptely using Microsoft Office Excel 2007 computer program and referring to Hardjosubroto (1994):

$$CIW = \left(\frac{IW - BW}{Age} \times \overline{X}_{Age} \right) + BW$$

WG = AFW − IW
CFW = CIW + WG

Where

CIW : corrected initial weight (kg)

CFW : corrected final weight (kg)

IW : initial weight before performance test (kg)

AFW : actual final weight after performance test (kg)

WG : weight gain (kg)

BW : birth weight (kg)

Age : age at end of test

$\overline{X}_{Age}$: average of age at end of the test (days)

Data of body measurements of cattle were compared to Indonesian National Standard (SNI) of minimum body measurements for SO cattle number, Indonesia National Standard (ISN): 7651.7:2016 (Table 3).

RESULT AND DISCUSSION

Body Weight

Birth weight. Table 4 shows the descriptive statistics of age and body weight at initial of the performance test in SO cattle. The BW of SO cattle was higher than other Indonesian native cattle such as Bali (17.80 ± 1.08 kg), Madura (15.74 ± 2.62 kg), Ongole grade/PO (26.10 ± 1.55 kg) and 13.52 ± 1.74 kg for Aceh (Kaswati et al., 2013; Yusran et al., 1995; Paputungan et al., 2015; Putra et al., 2014). Therefore, the average of BW was similar to other Bos indicus breeds such as Brahman cross (31.33 ± 3.52 kg), Nellore (32.30 ± 3.80 kg), Red Chittagong (16.74 ± 0.36 kg) and 20.00 ± 4.96 kg for Malawi Zebu (Muslim et

Table 2. Feed Nutrient Standard for SO Cattle at the Breeding Station (100% DM)

Nutrient	Quality 1	Quality 2	Quality 3
Macro			
Dry matter (%)	82.59	83.21	86.11
Crude protein (%)	7.61	12.44	12.73
Crude fat (%)	4.41	5.90	5.23
Crude fiber (%)	16.35	13.80	14.91
TDN (%)	59.00	64.72	68.87
ME Mcal (%)	1.71	1.96	2.32
Starch (%)	31.74	29.42	32.69
Lignin (%)	4.92	3.59	3.99
Minerals			
Ca (%)	1.55	2.06	0.73
P (%)	0.44	0.64	0.40
Mg (%)	0.10	0.12	0.15
K (%)	0.56	0.59	0.66
Na (%)	0.07	0.10	0.04
Fe (ppm)	517.29	488.06	563.32
Zn (ppm)	14.61	24.01	19.51
Cu (ppm)	6.07	6.89	8.05
Mn (ppm)	44.72	51.64	71.36
Mo (ppm)	0.12	0.24	0.17
S (%)	0.11	0.15	0.28
Cl (%)	0.00	0.05	0.00
Co (%)	0.12	0.00	0.00

Table 3. Indonesian National Standard (INS) of Minimum Body Measurements for SO Cattle at 24 to 30 Months of Age

Sex	Measurements (cm)	Class A	Class B	Class C
	Withers height	147	140	133
Male	Body length	145	138	131
	Heart girth	179	172	165
	Scrotal circumferance	28	28	28
	Withers height	132	127	122
Female	Body length	131	126	121
	Heart girth	165	160	155

Source: Directorate General of Livestock and Animal Health of Indonesia.

al., 2011; Tatiane et al., 2014; Rabeya et al., 2009; Nandolo et al., 2016). Meanwhile, the average of BW in *Bos taurus* group such as Friesian Holstein (33.90±0.90 kg), Angus (35.40±3.80 kg), Hereford (35.20±4.60 kg) and 49.20±7.10 kg for Belgian Blue (Ozkaya, 2013; Nugent et al., 1991; Kolkman et al., 2010). The average of BW in *Bos taurus* breed was higher than *Bos indicus*. A diversity in genetic, management and environment of animal may cause these differences.

Weaning weight. The average of weaning weight (WW_{205}) in SO cattle in this study is presented in Table 4. The WW_{205} in several Indonesian native cattle are Bali (88.59±16.15 kg), Brahman cross (107.13±19.25 kg), PO (109.10±18.35 kg) and 44.68±11.00 kg for Aceh (Kaswati et al., 2013; Duma and Tanari, 2008; Prihandini et al., 2011; Putra et al., 2014). The weaning weight of Indonesian native cattle (Bali and SO) are lower than African native cattle such as Bonsmara (215.00±10.90 kg) and Tuli (144.00±5.00 kg) as reported by Rakwadi et al. (2014). Weaning weight (6 months) of Red Chittagong are 43.20±1.40 kg (male) and 41.90±1.30 kg for female (Afroz et al., 2011) and lower than SO cattle. The weaning weight of female SO cattle in this study was higher than Bhagnari cattle (99.75±4.66 kg) and Droughtmaster x Bhagnari (105.47±2.02 kg) as reported by Waheed et al. (2003). The weaning weight of Nellore and Indubrazuil cattle were 185.00±29.20 kg and 182.53±30.00 kg, respectively (Tatiane et al., 2014; Rios-Utrera et al., 2013)

Yearling weight. The average of yearling weight (YW_{365}) in SO cattle in this study was presented in Table 4. The average of YW_{365} in several Indonesian native cattle such as Bali, Brahman cross, PO, and Aceh are 131.12±25.50 ; 254.32±47.91; 132.70±19.93; and 67.02±17.44 kg; respectively (Kaswati et al., 2013; Duma and Tanari, 2008; Prihandini et al., 2011; Putra et al., 2014). The YW_{365} of SO cattle in this study was higher than other Indonesian native cattle at the previous studies. Assan and Nyoni (2009) reported that the yearling weight of Tuli cattle were 180.89±1.73 and 161.29±1.59. Afroz et al., 2011 reported that the average of YW_{365} in Red Chittagong cattle are 64.00±3.30 and 68.40±3.20 kg for male and female, respectively. The body weight at 365 days of age was the important for bull and heifer selection (Prihandini et al., 2011). Mercadante et al. (2011) reported that selection of Nelore cow based on yearling weight could be increased the weight at 550 days of age. Meanwhile, the average of yearling weight in Nellore cattle are 268.09±39.47 kg (Regatieri et al., 2012).

Initial Weigh. Table 5 shows the descriptive statistic of age, body weight and weight gain at end of the performance test in SO cattle. Nahar et al. (2016) reported that the average of initial weight (IW) in Red Red Chittagong were 63.02±1.48 and 70.74±2.02 kg, respectively for male (360 days of age) and female (450 days of age) at about 1.5 years period of the test. Mashiloane et al. (2012) also maintained the initial age (IA) for Bonsmara and Nguni bulls about 355.50±30.91 days and 371.20±33.76 days,

Table 4. Descriptive Statistics of Age and Body Weight at Entrance of the Performance Test in SO Cattle

Period	Group / Performance	Parameters				
		Mean	SD	CV(%)	Min.	Max.
I	Bull (N = 13)					
	Age (days)	392.23	85.68	21.84	300.00	528.00
	Birth weight (kg)	26.77	1.36	5.09	25.00	30.00
	WW_{205} (kg)	113.67	25.24	22.47	45.64	143.82
	YW_{365} (kg)	164.65	37.17	22.58	118.02	252.59
	Initial weight (kg)	181.23	28.49	15.72	142.00	248.00
	Cow (N = 10)					
	Age (days)	386.10	43.63	11.30	319.00	473.00
	Birth weight (kg)	30.88	2.36	7.63	28.00	36.00
	WW_{205} (kg)	83.82	31.39	37.45	48.31	144.15
	YW_{365} (kg)	197.62	17.32	8.77	176.17	221.21
	Initial weight (kg)	138.80	44.05	31.74	91.00	221.00
II	Bull (N = 5)					
	Age (days)	432.00	116.64	27.00	323.00	575.00
	Birth weight (kg)	23.00	8.37	36.38	10.00	30.00
	WW_{205} (kg)	94.76	20.31	21.43	65.22	114.78
	YW_{365} (kg)	164.77	16.55	10.04	140.63	180.96
	Initial weight (kg)	192.00	50.59	26.35	149.00	251.00
	Cow (N = 7)					
	Age (days)	593.29	32.15	5.42	551.00	636.00
	Birth weight (kg)	21.86	3.02	13.83	16.00	25.00
	WW_{205} (kg)	106.40	14.47	13.60	89.33	128.44
	YW_{365} (kg)	160.20	25.48	15.90	130.57	200.04
	Initial weight (kg)	159.43	27.66	17.35	126.00	205.00
III	Bull (N = 7)					
	Age (days)	365.67	74.90	20.48	318.00	452.00
	Birth weight (kg)	22.00	5.83	26.50	15.00	32.00
	WW_{205} (kg)	103.93	37.76	36.33	62.30	163.19
	YW_{365} (kg)	143.97	29.81	20.71	107.93	187.38
	Initial weight (kg)	144.43	23.59	16.33	113.00	178.00
	Cow (N = 8)					
	Age (days)	384.00	112.23	29.23	309.00	646.00
	Birth weight (kg)	21.75	3.88	17.85	15.00	25.00
	WW_{205} (kg)	112.83	17.03	15.10	91.94	138.15
	YW_{365} (kg)	158.83	31.60	19.90	102.59	215.99
	Initial weight (kg)	169.25	40.37	23.85	126.00	253.00

N= number of observation; SD= standard deviation; CV= coefficient of variation; Min.= minimum value; Max.= maximum value; WW_{205}= weaning weight at 205 days of age; YW_{365}= yearling weight at 365 days of age

Table 5. Descriptive Statistic of Age, Body Weight and Weight Gain at End of the Performance Test in SO Cattle

Period	Group / Performance	Parameters				
		Mean	SD	CV(%)	Min.	Max.
I	Bull (N = 13)					
	Age (days)	1005.69	83.98	8.35	910.00	1138.00
	CIW (kg)	181.05	25.59	14.14	154.09	257.36
	CFW (kg)	473.90	24.13	5.09	438.35	508.81
	AFW(kg)	474.08	25.98	5.48	433.00	529.00
	WG (kg)	292.85	43.52	14.86	185.00	350.00
	Cow (N = 10)					
	Age (days)	759.80	42.09	5.54	688.00	842.00
	CIW (kg)	140.03	49.03	35.01	89.99	243.11
	CFW (kg)	317.33	50.23	15.83	254.30	396.73
	AFW(kg)	316.10	50.78	16.06	256.00	400.00
	WG (kg)	177.30	66.19	37.33	81.00	297.00
II	Bull (N = 5)					
	Age (days)	785.40	72.10	9.18	684.00	853.00
	CIW (kg)	194.25	54.85	28.23	139.31	262.87
	CFW (kg)	343.05	51.35	14.97	262.20	389.38
	AFW(kg)	340.80	62.64	18.38	241.00	400.00
	WG (kg)	148.80	79.10	53.16	82.00	236.00
	Cow (N = 7)					
	Age (days)	802.00	31.92	3.98	760.00	845.00
	CIW (kg)	158.83	23.58	14.85	131.16	200.41
	CFW (kg)	353.26	63.52	17.98	234.16	440.
	AFW(kg)	353.86	67.40	19.05	229.00	445.00
	WG (kg)	194.43	43.63	22.44	103.00	240.00
III	Bull (N = 7)					
	Age (days)	977.67	122.68	12.55	838.00	1068.00
	CIW (kg)	146.88	25.31	17.23	110.41	185.45
	CFW (kg)	357.60	80.15	22.41	262.00	480.41
	AFW(kg)	355.14	87.41	24.61	243.00	489.00
	WG (kg)	210.71	92.53	43.91	109.00	370.00
	Cow (N = 8)					
	Age (days)	870.63	172.01	19.76	695.00	1076.00
	CIW (kg)	160.07	40.15	25.08	99.30	220.90
	CFW (kg)	294.07	37.43	12.73	242.14	344.90
	AFW(kg)	303.25	49.57	16.34	230.00	374.00
	WG (kg)	134.00	48.07	35.87	86.00	233.00

N= number of observation; SD= standard deviation; CV= coefficient of variation; Min.= minimum value; Max.= maximum value; CIW= corrected initial weight; CFW= corrected final weight; AFW= actual final weight; WG= weight gain

respectively. Therefore, the IW in the performance test were 251.91±34.14 kg (Bonswana) and 180.54±33.76 kg (Nguni). Oikawa *et al.* (2006) reported that the average of IW and IA in Japanese Black bull at 112 days period of the test were 260.80±32.70 kg and 231.40±18.50 kg, respectively. The effective duration of performance test in cattle about 12 months with IW about 600 days of age (Hardjosubroto, 1994).

Final Weight. The average of AFW in SO cattle is presented in Table 5. Nahar *et al.* (2016) reported that the average AFW of Red Chittagong were 127.40±7.34 and 111.55±3.47 kg, respectively for male (900 days of age) and female (810 days of age). Mashiloane *et al.* (2011) obtained the AFW of Bonsmara and Nguni were 389.71±29.21 304.33±27.23 kg, respectively during one year of the test period. Reis *et al.* (2013) reported that the AFW in Nellore young bulls were 279.30 to 330.00 kg with average of IW about 243.00 to 245.90 kg at the 3 months of test period in grassland. Garcia *et al.* (2005) obtained the performance test for *Bos taurus* breeds (Angus, Charolais and Hereford) with IW about 300 kg could be reached respective AFW and WG about 500 kg and 1.65 kg/day at one year of the test period. Oikawa *et al.* (2006) obtained the average of AFW about 392.00±39.40 kg with final age about 231.40±18.50 days in Japanese Black bull. The AFW and test period in SO cattle in this study was higher than Bonswana, Nguni and Japanese Black at from the result of previous study. Long period of the test (±535 days) caused may cause a higher final weight and age. However, the age at end of the test for bull was about 1000 days (adult weight)

Genetic Parameters

   Heritability. Table 6 shows the variance components for estimated heritability (h^2) of YW_{365}. The h^2 value of YW_{365} in SO cattle could be the high category ($h^2 > 0.30$) with low standard error. A lower of SE than h^2 values suggested that this h^2 value was accurate for selection criterion (Warwick *et al.*, 1989). Selection of SO cattle could be conducted based on YW_{365}. High heritability value of YW_{365} were obtained in several Indonesian beef cattle such as Bali, Brahman cross, Simmental and Aceh are 0.54±0.32; 0.44±0.14; 0.43±0.19; and 0.49±0.59; respectively (Kaswati *et al.,* 2013; Duma and Tanari, 2008; Suhada *et al.,* 2009; Putra *et al.,*

2014). Previous studies showed that the heritability value of YW_{365} in several cattle breeds such as Red Chittagong, Tuli, Nguni, Golpayeganian, Bhagnari x Droughtmaster, Nellore and South African Limousin were 0.50±0.10; 0.18±0.001; 0.25; 0.48±0.07; 0.19±0.24; 0.36±0.01; and 0.16±0.03; respectively (Afroz *et al.,* 2011; Assan and Nyoni, 2009; Norris *et al.,* 2004; Khan *et al.,* 1998; Regatieri *et al.,* 2012; Niekerk and Neser, 2006)..

   Estimated Breeding Value. Table 7 shows the top ten of SO cattle based on breeding value of yearling weight (BV_{365}). The highest BV_{365} in bull and heifer in this study were 66.05 kg (ID: KBO175) and 41.89 kg (ID: KAR2091), respectively. Previous study showed that the higher BV_{365} in PO and Bali were 5.54 kg and 20.75 kg, respectively (Prihandini *et al.*, 2011; Supriyantono *et al.,* 2010). Rodriguez and Guerra (2013) obtained 30.40 kg of the BV for adult weight in Nellore. This research showed that total of 30 selected cattle (15 males and 15 females) from all test periods as presented in Table 8. Amount of six males (40%) and 11 females (73%) from both sex groups having positive BV value. Positive BV value must be used for livestock selection because this value indicates the individual performance from their herd.

Body Measurements and Groups

   Table 9 shows the descriptive statistic of body measurements in SO catle from the

Table 6. Heritability estimation of yearling weight at 365 days of age in SO cattle

Component	Value
N_S	5
N_P	47
$Var_{(S)}$	148.16
$Var_{(W)}$	620.64
k	9
h^2	0.77
SE	0.68

N_S= total of sire; N_P= total of progeny for estimation; c = constanta; h^2= heritability; SE= standard error; $Var_{(S)}$ = variance of sire; $Var_{(W)}$ = variance of individu

Table 7. Top Ten of SO Cattle in the Performance Test Based on Breeding Value of Yearling Weight at 365 Days of Age

Rank	Catttle ID	Sire	Dam	BW	WW_{205}	YW_{365}	BV_{365}
			Male				
1	KBO175	1999	11882	26	143.82	252.59	66.05
2	KBO174	1999	0338	27	137.75	200.87	26.23
3	3221	1129	0418	25	136.47	187.38	15.84
4	KBO170	1999	11910	27	128.46	185.96	14.75
5	KBO186	11936	11825	30	130.27	184.66	13.74
6	KBO167	1999	11843	26	135.52	182.50	12.08
7	2137	1999	0822	30	114.78	180.96	10.89
8	2908	1999	11925	30	112.00	176.00	7.08
9	2934	1976	1152	20	95.88	170.86	3.11
10	2924	2104	B0793	20	163.19	166.47	-0.26
			Female				
1	KAR2091	008843	0864	25	84.02	221.21	41.89
2	KAR2095	20244	0593	30	77.05	221.12	41.82
3	3274	1976	1322	25	138.15	215.99	37.87
4	KAR2102	08843	0824	30	135.70	210.22	33.43
5	KAR2101	008843	0823	30	144.15	207.28	31.16
6	KAR2099	20244	0908	36	74.25	205.22	29.27
7	3470	1129	0820	25	121.38	200.04	25.58
8	KAR2096	008843	0860	28	73.97	188.55	16.74
9	KAR2097	20244	10277	30	76.38	184.65	13.74
10	KAR2098	012075	0742	31	66.93	183.53	12.87

BW= birth weight; WW_{205}= weaning weight at 205 days of age; YW_{365}= yearling weight at 365 days of age; BV_{365}= breeding value of yearling (365 days of age) weight

performance test. The average of WH, BL, HG and SC in SO bulls were 138.08±9.74, 143.32±8.12, 179.44±14.32 and 29.80±3.51 cm, respectively. Therefore, the average of WH, BL and HG in SO cows were 128.00±6.73 cm, 136.14±7.71 cm and 167.51±9.58 cm, respectively. Previous study showed that the average WH, BL and HG in Bali bull from the 270 days of test were 117.61±6.40, 123.08±10.07 and 156.89±15.15 cm, respectively. Research showed that only one bull (KB0174) and five cows (KAR2093, KAR2098, KAR2091, KAR2101 and 3441) were grouped into class A. Four bulls from period I (KBO170, KBO174, 2934, 2908) were recommended for breeding bull

at the breeding station. Each selected bull could be used for breeding program at the breeding station.

All bulls at second period of the test were not included in the class group because of lower measurements than INS (Table 2), especially for WH. Meanwhile, only one bull at third period of test could be included into class C (Bull ID: 2986). It was concluded that the best duration test for bull was about 600 days (Period I) with age at initial of the test about 400 days. Meanwhile, the AFW of bull reached about 1000 days (± 3 years). Most of bulls from second test period were not grouped into any class groups because of the lower of WH than INS. However, genetic

Table 8. Top Five of SO Based on the Corrected Final Weight at the Breeding Station

Sex	Period	Rank	Cattle ID	Sire	Dam	Age (days)	BV$_{365}$	Class	Body Measurements (cm)					Weight Performance (kg)				
									WH	BL	HG	SC	BW	IW	AFW	WG	CIW	CFW
Bull	I	1	KBO171	1999	0933	939	-37.57	B	145	160	176	34	26	150	500	350	158.81	508.81
		2	KBO173	1999	011826	1,138	-4.35	C	145	146	164	33	25	201	529	328	180.54	508.54
		3	KBO170	1999	011910	977	14.75	B	145	150	210	29	27	168	504	336	172.14	508.14
		4	KBO174	1999	0338	954	26.23	A	148	153	200	29	27	175	476	301	183.02	484.02
		5	KBO187	11936	011809	910	-22.73	C	145	145	168	28	27	142	469	327	154.09	481.09
	II	1	2137	1999	0822	853	10.89	-	128	134	184	31	30	164	400	236	153.38	389.38
		2	R8.2985	1999	K0910	852	-8.78	-	129	137	177	33	25	149	383	234	139.31	373.31
		3	2934	1976	KU1152	747	3.11	-	129	135	181	35	20	251	355	104	262.87	366.87
		4	2908	1999	11925	791	7.08	-	131	134	174	29	30	243	325	82	241.49	323.49
		5	2925	0246	B0874	684	-20.16	-	130	136	152	26	10	153	241	88	174.20	262.20
	III	1	2986	1999	011826	1,076	-27.88	C	134	154	197	32	25	119	489	370	110.41	480.41
		2	1711	1999	0817	1,100	-3.30	-	130	152	183	30	32	150	451	301	136.88	437.88
		3	2924	0328	B0793	845	-0.26	-	129	133	174	29	20	163	363	200	185.45	385.45
		4	3221	1129	0418	1,027	15.84	-	124	135	166	30	25	178	337	159	170.65	329.65
		5	2919	1999	1029	830	-43.32	-	129	150	165	27	20	113	191	191	129.55	320.55
Cow	I	1	KAR2093	1999	0744	793	8.84	A	132	143	170	-	25	103	400	297	99.73	396.73
		2	KAR2098	012075	0742	756	12.87	A	141	144	180	-	31	99	367	268	99.34	367.34
		3	KAR2102	008843	0824	688	33.43	B	140	138	166	-	30	195	348	153	212.22	365.22
		4	KAR2091	008843	0864	842	41.89	A	134	138	172	-	25	166	372	206	152.23	358.23
		5	KAR2101	008843	0823	711	31.16	A	133	129	160	-	30	221	302	81	234.11	315.11
	II	1	3470	1129	0820	823	25.58	B	131	144	186	-	25	205	445	240	200.41	440.41
		2	3455	1129	011931	824	11.02	C	122	133	177	-	22	172	389	217	168.00	385.00
		3	3434	1129	0571	845	3.34	C	123	139	179	-	16	179	384	205	170.71	375.71
		4	3419	1129	011919	795	-27.90	B	128	146	175	-	22	156	367	211	157.18	368.18
		5	3403	1129	K0901	804	-23.73	C	125	128	173	-	22	137	199	199	136.71	335.71
	III	1	3274	1976	1322	695	37.87	B	128	132	165	-	25	197	321	124	220.90	344.90
		2	3441	1999	0566	1,073	2.14	A	132	135	176	-	21	141	374	233	109.53	342.53
		3	3442	1999	0761	1,069	-10.89	-	108	144	175	-	25	253	369	116	210.69	326.69
		4	3432	1976	1450	727	-49.45	C	125	146	163	-	20	157	288	131	184.07	315.07
		5	3404	1999	0913	774	1.24	-	117	124	163	-	25	159	280	121	175.73	296.73

WH= withers height; BL= body length; HG= heart girth; SC= scrotal circumferance; BW= birth weight; IW= initial weight before performance test; AFW= actual final weight; WG= weight gain; CIW= corrected initial weight CFW= corrected final weight; BV$_{365}$= breeding value of yearling (365 days of age) weight

Table 9. Descriptive Statistic of Body Measurements in SO Cattle at End of the Performance Test

Period	Group / Measurements (cm)	Mean	SD	CV(%)	Min.	Max.
	Bull (N = 13)					
	Withers height	146.85	2.73	1.86	144.00	152.00
	Body length	147.31	6.05	4.10	140.00	160.00
	Heart girth	185.08	13.75	7.43	164.00	210.00
	Scrotal circumferance	30.46	2.63	8.65	26.00	35.00
I	**Cow (N = 10)**					
	Withers height	135.70	3.23	2.38	132.00	141.00
	Body length	137.40	5.54	4.03	129.00	144.00
	Heart girth	166.20	6.89	4.15	158.00	180.00
	Bull (N = 5)					
	Withers height	129.40	1.14	0.88	128.00	131.00
	Body length	135.20	1.30	0.96	134.00	137.00
	Heart girth	173.60	12.66	7.29	152.00	184.00
	Scrotal circumferance	30.80	3.49	11.34	26.00	35.00
II	**Cow (N = 7)**					
	Withers height	125.86	3.08	2.45	122.00	131.00
	Body length	137.86	6.15	4.46	128.00	146.00
	Heart girth	177.43	6.68	3.76	167.00	186.00
	Bull (N = 7)					
	Withers height	128.00	3.96	3.09	122.00	134.00
	Body length	141.71	9.86	6.96	131.00	154.00
	Heart girth	173.14	13.85	8.00	154.00	197.00
III	Scrotal circumferance	27.86	4.60	16.51	18.00	32.00
	Cow (N = 8)					
	Withers height	123.75	7.74	6.26	108.00	132.00
	Body length	135.75	7.46	5.49	124.00	146.00
	Heart girth	164.63	9.52	5.78	148.00	176.00

N= number of observation; SD= standard deviation; CV= coefficient of variation; Min.= minimum value; Max.= maximum value

improvement of WH in SO could be increased through selection program. Top five bulls from the first test period could be used as breeding bull at the breeding station. The duration test and age at entrance of the test were the two important factors determining the cattle according to INS.

CONCLUSION

Livestock selection could be maintained based on breeding value (BV) and continued with the performance test. However, study for economic traits such as feed convertion ratio and

feed intake in the performance test were further needed for genetic improvement in livestock.

ACKNOWLEDGMENTS

REFERENCES

Afroz, M.A., M.A. Haque and A.K.F.H. Bhuiyan. 2011. Estimation of heritability for growth traits of Red Chittagong cattle in a nucleus herd. The Bangladesh Veterinarian. 28(1): 39-46.

Agung, P.P., S. Anwar, A.S. Wulandari, A. Sudiro, S. Said and B. Tappa. 2015. The potency of Sumba Ongole (SO) cattle: A study of genetic characterization and carcass productivity. J. Indonesian Trop. Anim. Agric. 40(2):71-78.

Assan, N. and K. Nyoni. 2009. Systematic enviromental influences and variance due to directand maternal effects and trends for yearling weight in cattle. Anim. Res. Int. 6(3): 1086-1092.

Becker, A. 1992. Manual of Quantitative Genetics. 4th Ed. Washington State University, Washington

Duma, Y. and M. Tanari. 2008. Potensi respon seleksi sifat pertumbuhan sapi Brahman cross di ladang ternak Bila River Ranch, Sulawesi Selatan. Prosiding Seminar Nasional Sapi Potong. Palu, 24 November 2008.

Falconer, R.D. and T.F. Mackay. 1996. Introduction to Quantitative Genetics. 4th Ed. Department of Genetics. North Canada University, Prince George

Garcia, M.D., M.G. Thomas, W.R. Parker, V.R. Beauchemin and R.M. Enns. 2005. Evaluation of performance trends in the Tucumcari Bull Test1961 to 2000. Research Report. 754:1-21.

Hardjosubroto, W. 1994. Aplikasi Pemuliabiakan Ternak di Lapangan. Gramedia Widiasarana Indonesia, Jakarta.

Hendro, W. 2010. Imbangan hijauan dan konsentrat yang berbeda pada penampilan sapi Sumba Ongole yang diberi tiga macam ransum penggemukan Tesis. Institut Pertanian Bogor, Bogor.

Kaswati, Sumadi and N. Ngadiono. 2013. Estimasi nilai heritabilitas berat lahir, berat sapih dan umur satu tahun pada sapi Bali di Balai Pembibitan Ternak Unggul Sapi Bali. Buletin Peternakan. 37(2):74-78.

Khan, M.S., M. Younas and M.A. Khan. 1998. Genetic and phenotypic (co)variance for yearling weight and post-weaning growth traits in Bhagnari x Droughmaster calves. Pak. J. Biol. Sci. 1(3):202-204.

Kolkman, I., G. Opsomer, S. Aerts, G. Hoflack, H. Leavens and D. Lips. 2010. Analysis of body measurements of newborn purebred Belgian Blue calves. Animal. 4(5):661-671.

Mashiloane, L, A. Bothma, K. Madia, J. Sebei and K. Nephawe. 2012. Growth and feed efficiency of range performance tested beef bulls in the arid sweet bushveld of South Africa. J. Anim. Sci. 2(4): 258-264.

Mercadante, M.E.Z., I.U. Packer, A.G. Razook, J.N.S.G. Cryllo and L.A. Figueiredo. 2003. Direct and correlated responses to selection for yearling weight on reproductive performance of Nelore cows. J. Anim. Sci. 81:376-384.

Muslim, K.N., N. Hary and S. Trinil. 2011. Hubungan antara berat badan induk dengan berat lahir pedet sapi Brahman cross pada jenis kelamin yang berbeda. Jurnal Ilmu-Ilmu Peternakan. 23(1):18-24.

Nahar, S., A.F.M.F. Islam, M.A. Haque and A.K.F.H. Bhuiyan. 2016. Animal performance of indegenous Red Chittagong cattle of Bangladesh. Acta Scientiarum. 38(2):177-182.

Nandolo, W, N.G. Timothy, and B. Mcloyd. 2016. Phenotypic and genetic parameters of calf growth traits for Malawi Zebu. LRRD. 28(2).

Niekerk, M. and F.W.C. Neser. 2006. Genetic parameters for growth traits in South African Limousin cattle. S. Afr. J. Anim. Sci. 36(5):6-9.

Norris, D., C. Banga, K. Benyi and B.C. Sithole. 2004. Estimation of genetic parameters and variance components for growth traits of Nguni cattle in Limpopo Province, South

Africa. Trop. Anim. Heal. Prod. 36:801-806.

Nugent, R.A., D.R. Notter and W.E. Beal. 1991. Body measurements of newborn calves and relationship of calve shape to sire breeding values for birth weight and calving ease. J. Anim. Sci. 69(6):2413-2421.

Oikawa, T., M.A. Haque, T. Hitomi, K. Suzuki and H. Uchida. 2006. Geneticparameters for traits in performance and progeny tests and their genetic relationships in Japanese Black cattle. Asian-Aust. J. Anim. Sci. 19(5):611-616.

Ozkaya, S. 2013. The prediction of live weight from body measurements on Holstein calves by digital image analysis. J. Agric. Sci. 151:570-576.

Paputungan U, R.N. Lentji and J.K. Hengky. 2015. Calf birth weight prediction accuracy using calf parturition, durability and metric body measurements in Ongole crossbreds heifers. Int. J. Biol. Sci. Appl. 2(1):10-14.

Park, B, T Choi, S. Kim and S.H. Oh. 2013. National genetic evaluation (system) of Hanwoo (Korean native cattle). Asian-Aust. J. Anim. Sci. 26(2):151-156

Priyanto, R, A.M. Fuah and E.L. Aditia. 2015. Peningkatan produksi dan kualitas dagng sapi lokal melalui penggemukan berbasis serealia pada taraf energi yang berbeda. Jurnal Ilmu Pertanian Indonesia. 20(2): 108-114.

Prihandini, P.W., L. Hakim and V.M.A. Nurgiartiningsih. 2011. Seleksi pejantan berdasarkan nilai pemuliaan pada sapi Peranakan Ongole (PO) di Loka Penelitian Sapi Potong Grati - Pasuruan. J. Ternak Tropika. 12(1):97-107.

Putra, W.P.B., Sumadi and T. Hartatik. 2014. Potensi respon seleksi sifat pertumbuhan sapi Aceh. JITV. 19(4):248-256

Rabeya, T, A.K.F.H. Bhuiyan, M.A. Habib and M.S. Hossain. 2009. Phenotypic and genetic parameters for growth traits in Red Chittagong cattle of Bangladesh. J. Bangladesh. Agril. Univ. 7(2):265-271.

Rakwadi, E., S.J. Nsoso, T.N. Gondwe and J.W. Banda. 2014. Estimates of phenotypic and genetic parameters and responses to selection in growth traits three breef cattle breeds raised under ranch conditions in Botswana. Bots. J. Agric. Appl. Sci. 10(1): 1-10.

Regatieri, I.C., A.A. Boligon, F. Baldi and L.G. Albuquerque. 2012. Genetic correlations between mature cow weight and productive and reproductive traits in Nellore cattle. Genet. Mol. Res. 11(3): 2979-2986.

Reis, R.A, A.L.S. Valente, S.M.C. Dos Santos, F.H.M. De Sauza, T.T. Berchielli, A.C. Ruggieri, S.S. Santana and J.M. Serra. 2013. Performance of young Nellore young bulls grazing marundu grass pasture at different heights. Tropical Grasslands. 1:114-116.

Rios-Utrera, A., V.D.H. Hernandez, E.V.A. Manjarrez, J.P.Z. Martinez and J.A.V. Cortes. 2013. Direct and maternal genetic effects for growth traits in Indubrazil cattle. Revista Cientifica. 23(5): 440-447.

Rodriguez, Y. and D. Guerra. 2013. Evidence of genotype-environment interaction for final live weight in the performance test of the Cuban Zebu. Cuban. J. Agric. Sci. 47(1): 13-17.

Suhada, H., Sumadi and N. Ngadiono. 2009. Estimasi parameter genetik sifat produksi sapi Simmental di Balai Pembibitan Ternak Unggul Sapi Potong Padang Mengatas, Sumatera Barat. Buletin Peternakan. 33(1): 1-7

Supriyantono, A., L. Hakim, Suyadi and Ismudiono. 2010. Evaluasi pejantan sapi Bali berdasarkan sifat pertumbuhan menggunakan metode Animal Model. Seminar Nasional Teknologi Peternakan dan Veteriner. Bogor, 12 Juli 2010.

Tatiane, C.S.C., L.C. Sabrina, E.B. Marcos, D.A.G. Daniela, G.F.G. Diego, B.D.N. Guilherme, O.R. Jaqueline, B.R. Raysildo and M. Danisio. 2014. Genetic analysis for gestation length, birth weight, weaning weight and accumulated productivity in Nellore beef cattle. Livest. Sci. 170: 16-21.

Waheed, A., A.U. Heyder and M.S. Khan. 2003. Genetic and phenotypic evaluation of the growth performance of Bhagnari and Bhagnari x Droughtmaster female calves in Pakistan. Pakistan. Vet. J. 23(3): 134-142.

Warwick, E.J., M. Astuti and W. Hardjosubroto. 1989. Pemuliaan Ternak. Gadjah Mada University Press, Yogyakarta

Yusran, M.A., K. Ma'sum and D.B. Wijono. 1995. Evaluasi nilai pemuliaan calon pejantan donor semen beku sapi Madura melalui program uji keturunan. Jurnal Ilmiah Penelitian Ternak Grati. 4(1): 17-23.