Reproductive performance of Bali cattle following artificial insemination in Bali

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Abstract

Bali cattle, domesticated of Banteng (*Bos javanicus*), is one of the important beef breeds in Indonesia. Reproductive performance data of Bali cattle from 5176 services and 2940 cows were collected from Jan 1998 to Sep 2003 during an AI program in Bali. Non-return rate (65%), service per conception (1.7), and conception rate (58.3) were comparable with other reports, both on Bali cattle and other breeds. However, calving interval (411±64 d) and days open (122±64 d) were longer than other breeds. In addition, there was a difference in conception rate between year and bull and number of services per month related to production site (AI centre).

Introduction

Bali cattle originate from the wild Banteng (*Bos javanicus*, syn. *Bos sondaicus*, *Bibos* (*Bos*) *banteng*) and are well utilized in traditional farming on the island of Bali (Darmadja, 1980). As one of indigenous and important beef cattle breeds in Indonesia, Bali cattle contribute to the development of livestock and agriculture. The breed is predominant especially in eastern Indonesia (e.g. NTB, NTT (West Timor), and South Sulawesi) and Lampung (Talib *et al.*, 2003). The cattle have a high heat tolerance, are well adapted to the dry-land, efficiently utilize low quality feed, and is considered to have a high fertility in a harsh environment However, Bali cattle have a small birth and weaning weight, high calf mortality (Talib *et al.*, 2003), slow growth rate (Mastika, 2003), low milk production (Oka, 2003), and are susceptible to infectious diseases, especially Jemhrana disease (Soeharsono el *al.*, 1995).

Although some reproductive performances of *Bali* cattle have been reported previously (Pane 1990, McCool 1992, Toelihere 2003, Susilawati *et al.* 2004). reports on reproductive performance after artificial insemination (AI) are limited. AI was first introduced in Bali cattle in southeast Sulawesi and Timor from 1975 to 1976 (Toelihere, 2003). In Bali, as source of pure Bali cattle, AI has been performed since 1980s with frozen semen produced by the National AI Centre of Singosari, East Java. Since 2001, frozen semen also has been produced by the local AI Centre of Bali province. The frozen semen was distributed throughout and also out of Bali. This report describes the reproductive performance of Bali cattle following AI on the island of Bali using frozen semen, produced by the Singosari AI centre and a Local AI centre. In addition, the effect of month, year, and bull on some traits was examined.

Material and Methods

Data were collected from one inseminator serving one area in the Badung district, Bali, from January 1998 to September 2003. Data include owner, address, cow identification, date of insemination. bull identification and batch of semen, pregnancy diagnosis, date of birth, birth weight, sex of calf and some remarks (for example: abortion or sold). From these data 90-days

non return service rate (NRR90), service per conception (S/C), first-service conception rate (CR), calving interval (CI), days open, gestation length, and sex ratio were calculated. Variation of CR was also evaluated based on month, year, and bull as well as producer of the frozen semen. The data were analyzed by chi square comparing CR between year or bull, and decomposition fit for displaying seasonal effect of total service and CR.

Results and Discussion

Data of 5176 inseminations and 2940 cows were obtained (Table 1). NRR90, S/C, and CR were 65.5%, 1.7, and 58.3 %, respectively. CI and days open collected from 650 cows and 1779 pregnancies were 411±64 d (13.5±2.1 mo) and 122±64 d, respectively. Gestation length was 289±5 days and birth weight was 19.1±1.0 Kg. Sex ratio was almost equal with the proportion of male slightly higher than those of female (52.8% vs. 47.2%, respectively).

Table 1 Reproductive performance of artificial insemination in Bali Cattle and other breeds

Variables	Bali cattle (*Bos javanicus*)		*Bos indicus*	*Bos taurus*
	This report	Other reports		
NRR56 (%)	-	-	-	53.0-72.8 [p]
NRR90 (%)	65.5%	-	-	65 [q]
S/C	1.7	1.7-1.8 [a] 1.8-2.0 [d]	-	1.7 [q]
CR (%)	58.3	41.5-57.6 [a]	-	52-68 [r]
Calving interval	411±64 d or 13.5±2.1 mo	430 d [b] 12.9-14.2 mo [a]	382 [k]	387.9 [q]
Days open (d)	122±64	118.3-152.7 [a]	98.6-114.9 [j]	81.6 [q]
Gestation length (d)	289±5	276-288 [d]	-	281.4 [s]
Birth weigh (Kg)	19.1±1.0	12.0-18.8 [b,c,d]	-	
Male	19.4±0.9	13.8 [d]		44.1 [s]
Female	18.6±1.0	11.2 [d]		41 3 [s]
Male (%)	52.8	60 [f]	-	48.8 [s], 52.9 [t]
Female (%)	47.2	40 [f]	-	51.2 [s], 47.1 [t]
Perinatal mortality (%)	3.1*	2.5-6.6 [f]	-	6.2±0.3 [s]

*estimation from conception-calving

[a] Susilawati *et al.* (2004), [b]Pane (1990), [c] Wijono and Yusran (1990), [d] Oka (1990), [e] Talib *et al.* (2003), Pohan *et al.* (2004) [j] Belloso *et al.* (1997), [k] Hinojosa *et al.* (19800, [p] Zhang *et al.* (1998), [q] Wall *et al.* (2003), [r] Patterson *et al.* (1999), [s] van Wagtendonk-deLeeuw *et al.* (1998), [t] Rorie *et al.* (1999)

Reproductive performance of Bali cattle during the AI program was moderate. With a limited number of inseminations (51 cows), Susilawati *et al.* (2004) have reported similar results for S/C, CR, CI, and days open of Bali cattle in Pringen, West Java. They reported that heavier cows had better reproductive performance than lighter cows. In this report, we did not have records on the weight or body condition score (BCS) nor on the age and parity of the cows that were used in the AI program. Performance of NRR and S/C in this report was similar with previous reports (Zhang *et al.* 1998; Wall *et al.*, 2003). However, CI and days open in this report were better than in the Pane (1990) report on Bali cattle, but longer than other breeds, like taurine and zebu cows (Wall *et al.*, 2003; Belloso *et al.*, 1997; Hinojosa *et al.*, 1980).

Reproductive efficiency in beef cows is influenced by nutrition, suckling, parity, genetic and environmental factors. Increasing nutrient intake after calving stimulated the secretion of anabolic hormones, promoted fat deposition, shortened the postpartum interval to estrus, and increased

pregnancy rate at the first estrus (Ciccioli *et al.*, 2003). The suckling effect and the maternal bond are important in regulating LH pulse frequency that influences ovulation of dominant follicles and shortened the postpartum anestrous interval in beef cows (Stagg *et al.*, 1998). The interval from parturition to first service and to conception was longer in primiparous than multiparous cows, because of the difficult recovery from the negative energy balance period and delayed initiation of ovarian cyclicity (Meikle *et al.*, 2004). Pregnancy rate in primiparous cows was also influenced by body condition (DeRouen *et al.*, 1994). High environmental temperature and humidity resulted in a marked decline in the quality of oocytes retrieved from *Bos taurus* cows but not from *Bos indicus* cows (Rocha *et al.*, 1998). Dairy cows in US showed seasonality of days open and the highest occurred in the Southeast of the USA due to heat stress (Oseni *et al.*, 2003). Zebu cows calving in the rainy season had a better calving interval than those in other seasons in a semi-humid tropical environment. This corresponds with abundant pasture, due to humidity and high temperatures (Hinojosa *et al.*, 1980). In Bali cattle, the pre-weaning body weight gain was higher in the dry season than in the rainy season, especially prominent in males, both in pure breed and bali-taurine crossbreed (Wijono and Yusran, 1990).

A fluctuation of CR was observed during the investigated period (Table 2). Using frozen semen from BIB Singosari, CR in 1998 was 59.3% then decreased in 1999 (56.4%) but increased in 2000 (58.5%) and reached maximum in 2001 (63.3%). From 2001 onwards, also frozen semen produced at the local AI centre was used. The CR for semen produced at the local AI centre was similar to those using frozen semen from Singosari AI centre (63.3 vs. 62.0% for that produced at Singosari AI centre and local AI centre, respectively), and then decreased dramatically in 2002 (54.9%; $P<0.05$) and then increased again in 2003 (58.7%).

Table 2 Annual fluctuation of conception rate (CR) during artificial insemination in Bali cattle during the period of 1998-2003

Years	Frozen Semen of	Total Services	CR (%)
1998	Singosari AI centre	975	59 3
1999	Singosari AI centre	981	56.4
2000	Singosari AI centre	880	58.5
2001	a Singosari AI centre	(417)	(63.3)
	b Local AI centre	(374)	(62.0)
	Sub total	791	62.7
2002	Local AI centre	924	54.9*
2003#	Local AI centre	625	58.7
Total		5176	58.3

Data until September 2003
* P<0 05

During the period of 1998-2003, two types of frozen Bali semen were used. The highest CR was found in 2001, while the production site did not significantly effect the results. Thus Bali province decided to use frozen semen wich was produced locally. In 2002, the CR significantly declined. That might be caused by new management of the distribution of semen and new experience in frozen semen production. Later, CR increased to the standard level.

Variation of the CR was found between bulls with a total of more than 100 services (Table 3). The CR of top-bottom ranked bulls varied more between those of the local AI centre than between those of Singosari AI centre. Based on a CR of more than 60%, the top three bulls were

bull no: 19252, 18827, and 19034 from Singosari AI centre and bull code: Pan, Ker, and Met from the local AI centre.

Ranking of the bulls according to CR can be predicted by NRR. Because not all of the cows that did not become pregnant were inseminated again, the CR was preferably used to predict the bull fertility. Based on this parameter, some top ranking bulls were present both in Singosari and in the local AI centre.

Table 3 Bull variation based on conception rate (CR) of artificial insemination in Bali cattle during the period of 1998-2003

Frozen Semen of	Code of Bulls	Total Services	CR (%)
Singosari AI centre	19252	253	64.8
	18827	205	61.0
	19034	790	60.9
	19032	109	59.6
	18629	552	58.9
	18925	526	58.4
	18613	636	55.7
Local Bali AI centre	Pan	114	65.8
	Ker	139	65.5
	Met	251	61.0
	Tra	326	59.2
	Mol	255	57.3
	Cad	253	56.5
	Kar	140	52.9
	Mar	122	49.2

The total number of services per month also varied, with higher numbers occurring in the transition from dry to rainy season (late of dry season and beginning of rainy season, (from August to November) (Figure 1). The pattern of CR per month is illustrated in Fig 1.

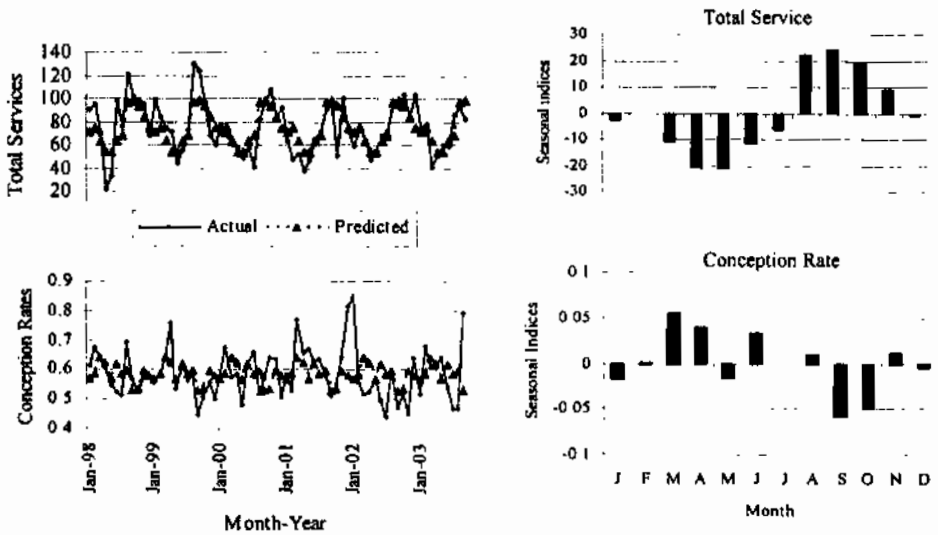

Figure 1. Monthly fluctuation of total number service and conception rate (CR) of artificial insemination in Bali cattle during the period of 1998-2003

The number of calvings per month is a good indicator of a seasonal effect on fertility, but not all calving data were recorded. The total number of services might have correlation with seasonality of fertility in this breed. This was relatively high in August to November similar to observations on Bali cattle in West Timor (Banks, 1980). Although the CR varied between months, a pattern was not as clear. The data support that the CR was not only influenced by season but also by other factors.

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References

Banks D. 1986. Analysis of livestock survey data 1985. In: NTTLDP Completion report. II. Livestock. 63-91. ACIL, Melbourne, Australia.

Belloso ES, Iglesia LR, Guevara L, and Castillo GS. 1997. Bull effect on the reproductive performance of mature and first calf-suckled zebu cows in the tropics. *Theriogenology* 48: 1185-1190

Darmadja D. 1980. Setengah abad peternakan Tradisional dalam Ekosistem Pertanian di Bali. Doctor Thesis. UNPAD Bandung

Hinojosa A, Franco A, and Bolio I.1980. Genetic and environmental factors affecting calvinginterval in a commercial beef herd in a semi-humid tropical environment. *Trop Anim Prod* 5:165-

Mastika IM. 2003. Feeding strategies to improve the production performance and meat quality of Bali cattle (Bos sondaicus). *In*: Entwistle K and Lindsay DR (eds). Strategies to Improve Bali Cattle in Eastern Indonesia. *ACIAR Proc* 110:10-13

Oka L. 2003. Performance of Bali cattle heifers and calves prior to weaning in a feedlot system. In: Entwistle K and Lindsay DR (eds). Strategies to Improve Bali Cattle in Eastern Indonesia. *ACIAR Proc* 110:14-16

Oseni S, Misztal I, Tsuruta S, Rekaya R. 2003. Seasonality of days open in US Holsteins. *J Dairy Sci* 86:3718-3725

Pane I. 1990. Upaya peningkatan mutu genetic sapi Bali di P3Bali. Proc Sem Nas Sapi Bali. A42-46

Patterson HH, Whittier JC, Rittenhouse LR, and Schuts DN. Performance of beef cows receiving cull beans, sunflower meal, and canola meal as protein supplements while grazing native winter range in eastern Collorado. *J Anim Sci* 77:750-755

Pohan A, Liem C, and Nulik J. 2004. Tampilan produktivitas ternak sapi Bali pada dua musim yang berbeda di Timor Barat. *Proc Sem Nas Teknologi Peternakan dan Veteriner*. p155-161

Rorie RW, Lester TD, Lindsey BR, McNew RW. 1999. Effect of timing of artificial insemination on gender ratio in beef cattle. *Theriogenology* 52:1035-1041

Soeharsono S, Wilcox GE, Dharma DM, Hartaningsih N, Kertayadnya G, and Budiantono A. 1995. Species differences in the reaction of cattle to Jembrana disease virus infection. *J Comp Pathol* 112:391-402

Susilawati T, Subagio I, Aulanni'am, Kuswati, Budiarto A, and Aristyo. 2004. The genetic and reproductive characteristic of Bali cattle on East Java. *Reprotech* 1:137-142

Talib C, Entwistle K, Siregar A, Budiarti-Turner S, and Lindsay D. 2003. In: Entwistle K and Lindsay DR (eds). Strategies to Improve Bali Cattle in Eastern Indonesia. *ACIAR Proc* 110:3-9

van Wagtendonk-deLeeuw AM, Aerts BJG, and den Haas JHG. 1998. Abnormal offspring following in vitro production of bovine preimplantation embryos: a field stdy. *Theriogenology* 49:883-894

Wall E, Brotherstone S, Woolliams JA, Banos G, and Coffey MP. 2003. Genetic evaluation of fertility using direct and correlated traits. *J Dairy Sci* 86:4093-4102

Wijono DB and Yusran MA. 1990. Pengaruh musim terhadap pertumbuhan pra sapih sapi Bali dan persilangannya. *Proc Sem Nas Sapi Bali*. C11-14

Zhang BR, Larsson B, Lundeheim N, and Rodriguez-Martinez H. 1998. Sperm characteristics and zona pellucida binding in relation to field fertility of frozen-thawed semen from dairy AI bulls. *Int J Andrology* 21:207-216