Journal of Cell and Animal Biology Vol. 5 (16), pp. 334-338, 30 December, 2011
Available online at http://www.academicjournals.org/JCAB
ISSN 1996-0867 ©2011 Academic Journals
DOI: 10.5897/JCAB11.067

Full Length Research Paper

Factors affecting conception rate in artificially inseminated cattle under farmers condition in Ethiopia

T. Woldu[1]*, Y. T. Giorgis[2] and A. Haile[3]

[1]Jimma University College of Agriculture and veterinary Medicine, Jimma, Ethiopia.
[2]Hawassa University, Hawassa, Ethiopia.
[3]International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia.

Accepted 8 December, 2011

This study was conducted in urban and rural areas of Adami Tullu district with objectives of evaluating factors affecting the efficiency of AI under farmers' situation and suggests options to be considered for improving the efficiency of AI delivery system. The overall conception rate attained in the study was 48.30% which is better than the national average conception rate reported so far. It was found out that the proportion of cows that successfully conceived significantly differed (P < 0.05) between the two locations (35 vs. 64.6%, for rural and urban, respectively). Moreover, overall conception varied with breed of cattle (P < 0.05), indigenous cattle (Arsi cows) attaining lower conception than the crossbred cattle. No significant differences were observed in conception rate among parities of cows and management system of cattle. There was a tendency of enhanced conception with increase in body condition of cows, although the effect was not significant. Over the 4-month period of supplementation, 60% of supplemented and 30% of control cows exhibited estrus (P>0.05) and the pregnancy rate was higher in supplemented than in control cows (42.9 vs 25%; P>0.05).

Key words: Artificial insemination, parity, breed, conception rate, heat detection.

INTRODUCTION

Despite the wide application and success of AI throughout the developed world, the success rate in African and other developing countries is still low owing to a number of technical, system related, financial and managerial problems (Azage et al., 1995). The history of artificial insemination of cattle in Ethiopia goes back to 1938 by the veterinary institute in Asmara the then part of Ethiopia (Tsegaye et al., 2002); however it faced a major challenge of low conception rate and repeat breeding of inseminated cows. A study by Desalegn (2008) indicated that conception rates to first inseminations in general were poor at the country level ranging from 7.14 to 40.23%. Another report indicated that the field AI efficiency in Ethiopia can be set between 2.5 to 3 inseminations per conception (NLDP, 2001) which can be categorized as poor efficiency that needs serious attention for improvement (Nebel, 1998).

Different factors were reported to affect the conception rate and fertility of cows/heifers reared under AI system. For instance Mukasa-Mugerwa et al. (1991b) studied reproductive performance of zebu cows reared under artificial insemination at Gobe ranch management in Ethiopia. In addition, other studies (Azage et al., 1981, 1992) also investigated the effect of supplementations and other factors on fertility of indigenous zebu cattle and their crosses. Most of the previous researches which were conducted to study the effect of different factors on fertility of cows reared with AI were carried out either on-research stations or under ranch management system. Hence, adequate information is lacking on performance of AI and factors affecting its efficiency under farmers' management systems in Ethiopia. The objectives of this study are therefore to evaluate factors affecting the performance of AI under farmers' situation and suggest options to be considered for improving the efficiency of AI delivery system in the future.

*Corresponding author. E-mail:tatekwbelete@yahoo.com.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Adami Tullu district of eastern Showa Zone of Oromiya region. The total land area of the district is estimated to be about 75,223 ha; of which 36,661 ha is under crop production and 17,113 ha is used as a grazing land. The remaining land is used for different purposes. It has a semi arid climate with an erratic average annual rainfall of 650 mm. The minimum and maximum temperatures are 12 and 26°C, respectively (ATARC, 2003). The total human population of Adami Tullu is about 111,926. Of the total population, 55,969 are male and 55,957 females. About 72% (39,818 male and 40,239 female) live in the rural areas while 31,869 (16,151 male and 15,718 female) dwell in the urban area. There are about 16,479 households of which 740 are female headed and the remaining male headed. The average family size per household is about 9.58 (ATARC, 2003).

Selection of animals

From rural and urban areas of Adami Tullu district, a total of 200 cows with different parities (from heifers to 4th parity) and genotypes (indigenous and crossbreds) were selected for the study. The indigenous cattle dominant in the study area are Arsi breeds. Arsi breed are mainly found in the central highlands of Ethiopia especially in Arsi, Shewa and Bale administrative regions. Their number is estimated over 2,012,000 (Rege, 1999). They are small, short and compact. Red with a black muzzle is the predominant color although many animals are black, light grey or white with black spots. They are classified as zebu cattle type (Albero and Haile-Mariam, 1982; DAGRIS, 2006). The crossbred cattle used in the study are crosses of Holstein Frisians and indigenous Zebu cattle of Ethiopia. The selection of the animals was based on rectal palpation for the presence of pregnancy and cystic ovary; those diagnosed positive for both incidents were not selected for the study. Moreover, cows that had history of abnormal calving (for example, dystocia, retained placenta and prolapse of the uterus) were not selected. Farmers agreed to manage the selected cows separately and prevent from mating with local bulls.

Heat detection and insemination procedure

Before the commencement of the project, farmers were trained for heat detection and appropriate time of insemination. They selected a contact farmer to closely monitor the animals and report the heat at the appropriate time. A standard semen handling and insemination procedure recommended by IAEA (2005) was used to inseminate the selected cows. Cows/heifers noted in heat in the morning were inseminated that afternoon and those identified in the afternoon were inseminated the next morning based on the "am-pm guideline" (Peter and Ball, 1995). Two inseminators were randomly assigned to inseminate cows in heat. During the study the following data were collected: conception (determined by rectal palpation 60 to 90 days following insemination), inseminator identity, cow identity, day of insemination, farming area, cattle breed, parity, body condition score using a scale ranging from 1 (emaciated) to 5 (obese), and cattle management system (extensive and intensive systems).

In order to see the effect of supplementation on the success of AI, 20 F1 crossbred (Borana with Holstein Friesian) animals managed by farmers were selected. The cows were at their first parity and on average over 6 months of postpartum. From the selected animals, 10 grazing cows were supplemented with concentrate and the others 10 cows were kept on grazing without supplementation (control groups). The concentrate mix was 49% nougcake, 49% wheat bran and 1% salt. The supplemental feed provided a nutrient of 24.30% CP and 9.81 MJ/kg DM ME. The level of supplementation was adjusted at 2% of live weight of the animal on dry matter basis. The supplemental feed was offered after the animals returned home after grazing for approximately 10 hours. Each of the supplemented animals belonged to a single farmer so that individual feeding is practiced during supplementation. Data on daily intake (for supplemented groups), body condition score (1 to 5 system) at the start and end of the experiment, time of heat exhibited, date of insemination and pregnancy diagnosis after 90 days was collected for supplemented and un-supplemented groups. The feeding trial was undertaken for a total of 120 days starting from 1st of December to end of March, which represent the dry season in the study area.

Data analysis

The Chi-square test procedure of SPSS (SPSS, 1999) was used to analyze data generated on factors affecting conception rate. The factors included were: effect of inseminator, effect of breed (indigenous Vs cross), effect of management (extensive and intensive), effect of body condition score (1 to 5), effect of parity (heifers to more than 4 parity) and location of the farm (Rural vs. Urban area). In addition, the effect of supplementation on conception rate and proportion of cows exhibiting heat symptoms was analyzed using the chi-square test.

RESULTS

The overall conception rate attained in this study was 48.3% and it was disaggregated to different factors affecting the success rate of AI in the study area. Significant ($P<0.05$) difference was observed in success of AI between crossbred and indigenous Zebu cattle types (Table 1). In this study, the overall conception rate was 58.6 and 32.8% for crossbred and indigenous Zebu cattle, respectively.

Although there is no significant ($P>0.05$) deference in conception rate among the different parity groups, heifers tend to have lower conception rate (34.3%) than cows at advanced parities (Table 1). Also, conception rate tends to increase till the third parity and start to decline in cows at 4th and above parities. In the present study, conception rate tended to increase as the body condition of the animals increased, but the difference was non-significant ($P>0.05$).

Other factor considered in this study was the effect of management system on the success of AI. Accordingly, intensive management system (cows that were kept around homestead and fed through cut and carry system) was compared with extensive system, whereby animals were allowed to graze at the field and shelter in barns during the night. The results indicated that 52.8% of conception was attained under the intensive management and 43.8% under extensive management system. Although the Chi square test did not declare significant difference ($P>0.05$) between the two management systems, a difference of 9% conception rate is not something to ignore under farmers conditions when the price of milk and crossbred animals is alarmingly

Table 1. Effect of different factors on overall conception rate of cows at the study area.

Parameter	NOS	NOC	OCR	X^2-value	P-value	Sig. level
Cows breed				9.321	0.002	**
Cross	87	51	58.6			
Indigenous	58	19	32.8			
Location				12.59	0.00	**
Urban	65	42	64.6			
Rural	80	28	35.0			
Parities				6.86	0.144	NS
Heifers	35	12	34.3			
First	46	22	47.8			
Second	26	15	57.7			
Third	21	14	66.7			
Four and above	17	7	41.2			
Management				1.161	0.181	NS
Extensive	73	32	43.8			
Intensive	72	38	52.8			
Technician				0.190	0.394	NS
1	69	32	46.4			
2	76	38	50.0			
Condition				0.405	0.817	NS
2.5	17	7	41.2			
3-3.5	84	41	48.8			
>4	44	22	50.0			
Overall	145	70	48.3	-	-	-

NOS, Number of service; NOC, number of conception; OCR, overall conception rate; **, P < 0.01; NS, non significant.

increasing. The results of the study revealed that a significant difference (P>0.05) was not observed between the two inseminators in conception rate.

Supplementation of diet (with 24.30% CP and 9.81 MJ/kg ME) for a duration of four months had significantly (P<0.05) improved the body condition of the cows than the un-supplemented (control) groups (3.20 vs 2.85, respectively). The proportion of cows that came into to heat was 60% in the dietary supplemented groups than the control group (30%) but the difference was not statistically significant (Table 2). Similarly, higher proportion of inseminated cows conceived among the supplemented cows (42.9%) compared to un-supplemented cows (25.0%), although the difference was not significant. The two groups of cows did not significantly differ in both studied variables (exhibiting heat and conception rate) may be due to the relatively small number of cows considered under each experimental group (10 cows per group).

Nonetheless, a difference of 30 and 18% in proportion of cows that exhibited estrus and conception rate between supplemented and un-supplemented groups, respectively observed in this study had greater practical implication even if the chi-square test did not declare significant differences between the groups. Absence of significant difference is probably due to smaller sample size for the study.

DISCUSSION

The overall mean conception observed in this study (48.3%) was higher than the average national conception rate in Ethiopia (27.06%) reported by Desalegn (2008). But lower than the report of researchers within the tropics such as Galina and Arthur (1990) who reported higher proportions of 63 to 71%. Differences between studies can be attributed to a multitude of factors; nonetheless, it is encouraging to note that Arthur et al. (1996) reported that when using AI to breed cattle, the aim should be to attain conception from 40 to 60%.

The lower conception rate of indigenous cows compared to the crosses is in line with the observation of several authors who also reported low conception at first insemination in zebu cattle (Azage et al., 1981; Kiwuwa et al., 1983; Mukasa-Mugerwa et al., 1991a; Kaziboni, et al., 2004). Some of the possible reasons for lower proportions of indigenous cows conceiving at first insemination are related to the difficulty of detecting estrus signs in zebu cattle. For instance Zebu cattle does not exhibit overt estrus signs like the crossbreds and/or exotic breeds (Mukasa-Mugerwa et al., 1991b); as well

Table 2. Effect of nutrient supplementation on reproductive performance of F1 crossbred cows under farmers conditions (n=20).

Parameter	Supplemented	Non-supplemented	Significance
DM intake (kg/day)	3.12	-	
Initial BCS	2.85	2.95	ns
Final BCS	3.20	2.85	*
Cows in estrus (%)	60.00	30.00	ns
Conception rate (%)	42.90	25.00	ns

*, P < 0.05; ns = non significant; DM = dry matter; BCS = body condition score.

as estrus in the Zebu tends to be shorter and is often subdued (Mattoni et al., 1988). Furthermore, Zebu cows often refrain from repeated mounting (Dawuda et al., 1989). Estrus detection is therefore more difficult in Zebu than in *Bos taurus* cattle because of these physiological conditions. In addition to the physiological factors, farmers tend to give more emphasis in close follow up of their crossbred cows than the indigenous ones. This may also contribute to the better overall conception rate of crossbred cows than the indigenous ones.

The absence of significant differences between parities in conception rate in this study was consistent with the study of Perez et al. (1999). On the other hand, other studies (Mukasa-Mugerwa et al., 1991b; Kaziboni et al., 2004) reported the presence of significant differences among different parity groups. For instance, Mukasa-Mugerwa et al. (1991b) reported significantly higher conception to first service for cows in the second (68%) and third (23%) parities than the fourth (7%) and subsequent calving (2%). The inconsistencies of the reports arise due to the differences in environment and circumstances that are unique to each study.

Conception rate tended to increase as the body condition of the animals increased, but the difference was non-significant (P>0.05). Normally, good body condition of cows is expected to have a positive impact on conception rate (Rowlands et al., 1994). The results in this study did not fully substantiate this assumption may be because the cows considered were within narrow range of body condition to significantly differ in conception rate. Nevertheless, the findings of this study agreed with those of Kaziboni et al. (2004) who also noted no appreciable difference on conception rate among different body condition of cows kept by smallholder farmers in Zimbabwe.

The difference in conception rate between urban and rural areas of the study was highly significant (P<0.01) with an average of 64.6 and 35.0%, respectively. The difference is probably attributed to the fact that the AI service users at the urban areas closely monitor the heat symptoms of the animals and in most cases crossbred animals are kept by urban farmers. In addition, the urban farmers fetch considerable amount of money from selling of raw milk to urban residents and hence they give due attention for their animals. On the other hand, farmers living in rural areas prefer natural mating than AI for rearing cattle and monitoring of heat in such system is quite difficult for the farmers as they are engaged in various farm activities. Still, the conception rate of 35% attained at rural areas indicated the presence of some opportunities to extend the AI service to rural areas with improving the capacity of farmers in heat detection and other cattle husbandry practices.

The improvement in proportion of cows coming to heat and subsequent conception rate in supplemented group than the control group is similar with the observation of Azage et al. (1992) who studied the effect of supplementation in Small East African Zebu cows that calved during the dry season. The authors revealed that 65% of supplemented and 53% of control cows exhibited estrus (P>0.05). They also reported that pregnancy rate was higher in supplemented than in control cows (37 vs 33%, P>0.05). The significant improvement in body condition score as a result of supplementation observed in the current study is not in agreement with findings of the same author who reported body weight and condition score at calving did not differ among the treatment groups. Similarly, Maquivar et al. (2006) who evaluated the effect of supplementation on grazing crossbred heifers (*Bos taurus* × *Bos indicus*), revealed that body condition score and length of estrus were not affected by supplementation. Also, the same authors reported that after the dietary supplementation period, percentage of heifers that exhibited estrous cycles was greater ($P < 0.05$) in the supplemented (52.3%) than control (41.4%) group where as pregnancy rate was similar for both groups ($P > 0.05$) (60% in the supplemented and 47% in the control group).

Several studies demonstrated a great variability in response to a dietary supplementation program (Grings et al., 1998; Azage et al., 1992; Maquivar et al., 2006). Khireddine et al. (1998) working with feeds dense in energy content plus implementation of estrous synchronization programs suggested that the use of a supplement improved ovarian follicular development and pregnancy rate, but response was affected by the energy concentration in the diet. In addition Grings et al. (1998) suggested that supplemental feeding of pre-pubertal animals tended to increase fertility and advance puberty.

Dietary supplementation in the present study also indicated attainment of encouraging improvement in proportion of cows coming into heat and subsequent

conception rate.

Conclusions

The better overall conception attained in this study under farmers' management situation is encouraging, depicting the fact that if appropriate semen handling and insemination procedure is employed, it is possible to attain better results. In addition, insuring the participation of farmers in the whole process of the project and building the capacity of farmers in heat detection and other husbandry practices were vital in attaining this result; hence future works should consider the involvement of farmers in each steps of the AI delivery system.

ACKNOWLEDGEMENTS

This study is financed by JICA (Japanese International Cooperation Agency) of the FRG (Farmers Research Group) project. The author also gives thanks to all individuals who contributed their share during execution of the study.

REFERENCES

ATARC (2003). Adami Tullu Agricultural Research Center, strategic planning and management document, P. 67.

Albero M, Haile-Mariam S (1982). The indigenous cattle of Ethiopia. Part I. World Anim. Rev., 41: 2-10.

Arthur GH, Noakes D, Pearson H (1996). Veterinary Reproduction and Obstetrics, 7th Edition. Saunders, London. UK, p. 46-57.

Azage T, Galal ESE, Beyene K (1981). A Study of Local Zebu and F1 Crossbred (European x Zebu) Cows. Ethiopian J. Agric. Sci., 3: 2-8.

Azage T, Entwistle KW, Mukasa-Mugerwa E (1992). Effects of supplementary feeding and suckling intensity on postpartum reproductive performance of small East African Zebu cows. Theriogenology, 38(1): 97-106.

Azage T, Lahlou-Kassi A, Mukassa-Mugrwa E (1995). Biotechnology in animal production. Development Opportunities in Livestock Agriculture. Proceedings of the Second Annual Conference of the Ethiopian Society of Animal Production, 26-27 May, 1993, Addis Ababa, Ethiopia, pp. 49-80.

DAGRIS (2006). Domestic Animal Genetic Resources Information System. Rege JEO, Ayalew W, Getahun E, Hanotte O, Dessie T (eds). International Livestock Research Institute, Addis Ababa,Ethiopia. http://dagris.ilri.cgiar.org.

Dawuda PM, Eduvile LO, Esievo KAN, Molokwu EC (1989). Silent oestrus manifestation in Nigerian Bunaji Zebu cows, Anim. Reprod. Sci., 21: 79-85.

Desalegn G (2008). Assessment of Problems/Constraints Associated With Artificial Insemination Service in Ethiopia. MSc thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit.

Galina CS, Arthur GH (1990). Review of Cattle Reproduction in the Tropics Part 4: Oestrous cycles. Anim. Breed. Abst., 58: 899-925.

Grings JB, May RA, Bellows, RE, Short S, Staigmiller RB (1998). Effect of nutritional management, trace mineral supplementation and norgestomet implant on attainment of puberty in beef heifers, J. Anim. Sci., 76(1998): 2177-2181.

IAEA (2005). Improving artificial breeding of cattle in Africa. Guidelines and recommendations. A manual prepared under the framework of an IAEA Technical Cooperation Regional AFRA Project on Increasing and Improving Milk and Meat Production, with technical support from the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. http://www-naweb.iaea.org/nafa/aph/public/te_1437_web.pdf .

Kaziboni S, Kusina NT, Sibanda S, Makuza S, Nyoni O, Bhebhe E (2004). Performance of artificial insemination in smallholder dairies of Nharira-Lancashire in Zimbabwe. Livest. Res. Rural Dev., 16(4).

Khireddine B, Grimard AA, Ponter CH, Ponsart JP, Boudjenah D, Mialot C, Sauvant P, Humblot (1998). Influence of flushing on LH secretion, follicular growth and the response to estrus synchronization treatment in suckled beef cows, Theriogenology, 49: 1409-1423.

Kiwuwa GH, Trail JCM, Worku G, Anderson FM, Durkin J (1983). Crossbreed Dairy Cattle Productivity in Arsi Region, Ethiopia. ILCA Research Report. # 11. ILCA, Addis Ababa, Ethiopia.

Maquivar M, Galina CS, Verduzco A, Galindo J, Molina RS, Mendoza MG (2006). Reproductive response in supplemented heifers in the humid tropics of Costa Rica. Anim. Prod. Sci., 93(1-2): 16-23.

Mattoni M, Mukasa-Mugerwa E, Cecchini G, Sovani S (1988). The reproductive performance of East African (Bos indicus) Zebu cattle in Ethiopia. Oestrous cycle length, duration, and behaviour and ovulation time. Theriogenology, 30: 961-971.

Mukasa-Mugerwa E, Tegegne A, Ketema H (1991a). Patterns of post partum oestrus onset and associated plasma progesterone profiles of cows in Ethiopia. Anim. Reprod. Sci., 24: 73-84.

Mukasa-Mugerwa E, Tegegne A, Mesfin T, Telku Y (1991b). Reproductive Efficiency of *Bos indicus* Cows Under Artificial Insemination Management in Ethiopia. Anim. Reprod. Sci. J., 24: 63-72.

Nebel RL (1998). Your Herd's Reproductive Status. Virginia Tech.

NLDP (2001). Plan for artificial breeding services. NLDP (national Livestock Development Project), Addis Ababa, Ethiopia, p. 212.

Perez E, Rodriguez F, Sepulveda NG, Risopatron J (1999). Use of Nuclear Techniques for Evaluation of First Service Conception Rate in Dairy Herds with Artificial Insemination in Chile. Proceedings of a Final Research Co-ordination Meeting Organized by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and Held in Uppsala, Sweden, IAEA-TECDOC-1220.

Peter AR , Ball PJH (1995). Reproduction in Cattle, Second Edition, Blackwell Pres, Oxford, U.K.

Rege JEO (1999). The state of African cattle genetic resources. I. Classification framework and identification of threatened and extinct breeds. FAO/UNEP Anim. Gen. Res. Info. Bull., 25: 1-25.

Rowlands GJ, Woudyalew M, d'Ieteren E, Leak GD, Nagda SM (1994). Effects of trypanosomiasis on reproduction of the East African Zebu cows exposed to drug-resistant trypanosomes. Prev. Vet. Med., 21: 237-249.

SPSS (1999). User's guide. Michigan, III. SPSS Inc.

Tsegaye S, Mureja S, Tesfaye C (2002). Experience on field AI management in Ethiopia. Livestock in Food Security Roles and Contributions. Proceedings of 9th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 30-31, 2001. ESAP (Ethiopian Soc. Anim. Prod.), pp. 433.