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Efficacy of a Cue-Mate Intravaginal Insert and Injection of Prostaglandin $F_{2\alpha}$ for Synchronizing Estrus in Hanwoo Cattle

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ABSTRACT

The present study was performed on farm animals to test the effectiveness of progesterone-releasing intravaginal device (Cue-Mate® 1.56 g) and injection of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) for synchronization estrus in Hanwoo cattle. The cattle were at random stage of the estrus cycle. The cows were artificially inseminated at day 7 after Cue-Mate withdrawal, using commercial semen from Korean native bulls. There was a season effect on the estrus synchronization rate. It was higher in spring (94.3%) followed by winter (93.3%), autumn (90.4%) and summer (67.2%). In summary, The results of this study revealed that season has influences on estrus behavior of cattle with no significant effect on pregnancy rate. In summary, we suggest summer reproductive management to alleviate the effects of heat stress. It should be based on intensive cooling combined with hormonal treatment. Given that different subgroups of cows benefit differently from the treatments, selective hormonal administration should be considered.

(Key words: estrus, synchronization, CIDR, Cue-mate)

INTRODUCTION

Several methods can be used to synchronize estrus in cattle (Patterson *et al.*, 1989; Odde, 1990; Larson and Ball, 1992). Most methods employ an injection of prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) that regresses the corpus luteum (CL). Regression of the CL (luteolysis) is followed by the development of a preovulatory follicle, behavioral estrus, and ovulation (Lauderdale *et al.*, 1974). Prostaglandin $F_{2\alpha}$, however, will not regress developing CL that is present in the ovary during the first five days of the estrous cycle (Lauderdale, 1972). Estrus can be synchronized by shortening the luteal phase with $PGF_{2\alpha}$ or by artificially extending it with progestins (Odde, 1990; Beal, 1998). Typical Fixed Time Artificial Insemination (FTAI) protocols use combinations of progestin and progesterone (P4) implants, oestradiol benzoate (ODB), $PGF_{2\alpha}$ and equine chorionic gonadotrophin (eCG)(McGowan, 1999; Bo *et al.*, 2003; Baruselli *et al.*, 2004). Short-term treatment with intravaginal progesterone (P4)-releasing inserts (CIDR-B, InterAg, Hamilton, New Zealand) produced tight synchrony of estrus, but fertility was variable and related to duration of insert treatment (Iwazumi *et al.*, 1994; Xu and Burton, 2000). The select synch protocol (injection of GnRH 7 d before an injection of $PGF_{2\alpha}$) produced estrus detection, conception, and pregnancy rates in beef heifers similar to those achieved after feeding melengestrol acetate for 14 days followed in 17 to 19 days of $PGF_{2\alpha}$ or two injections of $PGF_{2\alpha}$ (Stevenson *et al.*, 1997). Generally, $PGF_{2\alpha}$ have been used for estrus synchronization, either by themselves or in combination with progestins, estrogens, and gonadotropin-releasing hormone (GnRH)(Weems *et al.*, 2006). Furthermore, $PGF_{2\alpha}$ may enhance the effects of exogenous progesterone on the hypothalamus after progesterone withdrawal, thereby increasing pituitary responsiveness to GnRH (Randel *et al.*, 1996) and inducing ovulation in ewes and cattle (Murdoch and McCormick., 1993).

Our objectives were to compare: 1) the ability of injection of $PGF_{2\alpha}$ to synchronize estrus; and 2) the variability of estrual characteristics in Hanwoo cattle before their first AI (Artificial Insemination) and with their next eligible estrus preceding their second AI.

MATERIALS AND METHODS

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1. Synchronization Treatments and AI

Estrous cycles of all experimental animals were synchronized using a Cue-Mate (containing 1.56 g progesterone, BIONICHE, New Zealand, ES Plastics Inc.) intravaginal device for seven days and at same time by removing the cue-mate a 2.5-ml (i.m.) injection of $PGF_{2\alpha}$ (Lutalyse^{TM}, Pfizer). Cows were inseminated using the AM/PM rule, where in a cow observed in standing estrus in the morning is inseminated in the afternoon of the same day, and a cow observed in standing estrus in the afternoon or evening is bred the following morning. Detection of estrus was done with the aid of a tail paint. It was performed four times with in a 24-hour period for 20 minutes (i.e., 6-hour intervals). All inseminations were performed by experienced technicians from commercial AI companies or by the herd owners and farm staff licensed to carry out AI. The study was conducted once in every season Spring (March～May), Summer (Jun～August), Autumn (September～November) and Winter (December～February) and in two regions, Pyeongchang-gun (one farm) and Yecheon-gun (two farm). For this study, 251 heads of Korean native cattle have been used. Pregnancy diagnosis was carried out about 60 days by uterus promotion.

2. Statistical Analysis

Differences among treatments were analyzed using the General Linear Model (GLM) procedure in the Statistical Analysis System package (version 6, 12). A probability of $P<0.05$ was to be statistically significant.

RESULTS

In winter estrus synchronization process, 45 heads of Hanwoo cattle were treated in Pyeongchang gun and Yecheon gun. Pregnancy rates ranged from 80.0 to 100% with an average of 91.1% after the second AI (Fig. 1). On the first conception rate ranged from 53.3 to 80%, with an average of 68.8% (31/45).

In spring, 36 heads were treated. On the first conception rate ranged from 72.7 to 86.6% with an average of 80.5% (29/36), while the second rate ranged from 90.9 to 100% with an average of 94.4% (34/ 36) (Fig. 2).

In summer, estrus synchronization treatment was done in 107 cows. On the first time of conception the rate ranged from 52.6 to 80 %, with an average of 67.2% (72/107). While on the second time it ranged from 81.5～100% with an average of 89.7% (96/107) (Fig. 3).

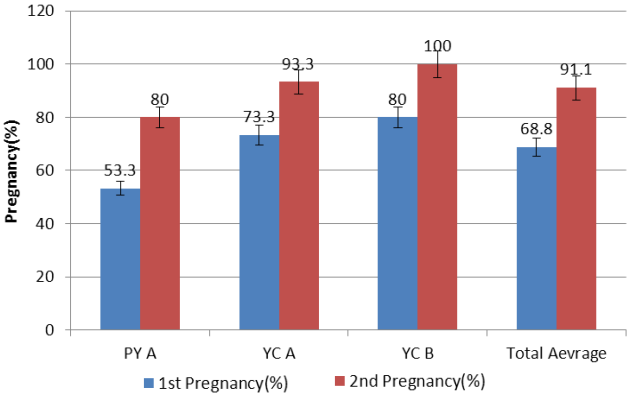

Fig. 1. Winter estrus synchronization treatment in accordance with the regional conception rate and pregnancy rate.

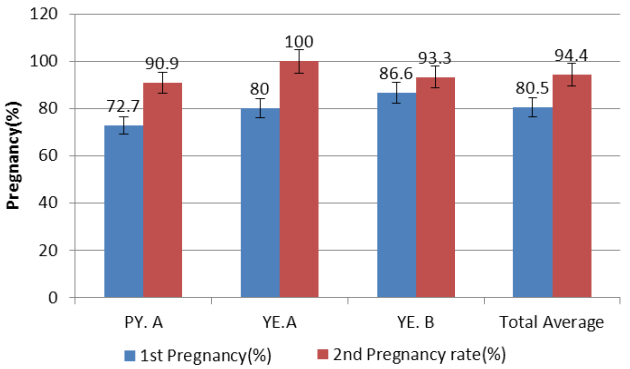

Fig. 2. One pregnancy rate and repair rate concept, regional spring estrus synchronization treatment-related.

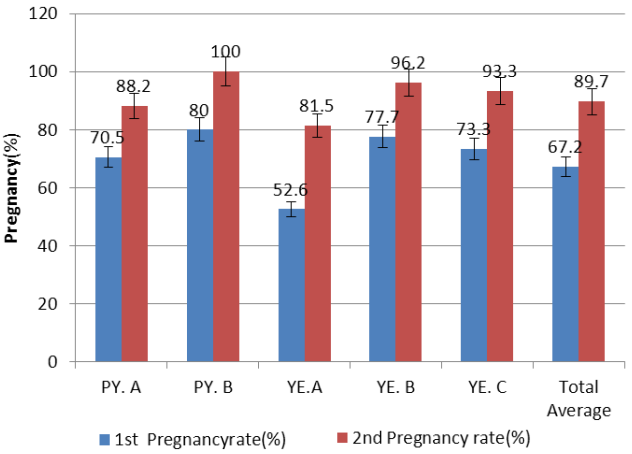

Fig. 3. Pregnancy rate and one of the concepts repair rate over the same period due to the summer heat treatment area.

In autumn, on the other hand, the estrus synchronization treatment was done in 63 heads (Fig. 4). After modifying the

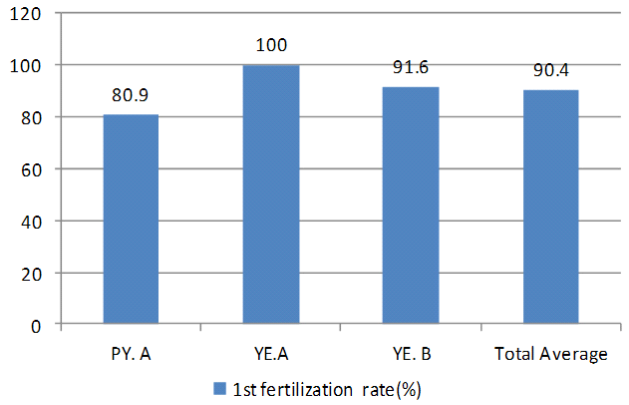

Fig. 4. Once the area is estimated estrus synchronization treatment-related pregnancy rate correction.

pregnancy the rate ranged from 80.9 to 100%, with an average of 90.4% (57/63). The pregnancy rate is the future research program. The results showed that regardless of elevation - high (Pyeongchang) and middle (Yecheon),- pregnancy rates would be similar in the different seasons (Fig. 5).

Once the amendment is estimated pregnancy rate due to Pyeongchang, summer, spring season estrus, appeared in the winter of orders, once corrected conception rate estimates because of Liquan County, spring, summer and winter seasons estrus synchronization in turn, results are displayed. Generally cooling systems are widely used in dairy farms to alleviate stress caused by summer heat. However, their ability to prevent its negative effects on reproduction is limited. Moreover, hormonal treatments given alone are not efficient at improving the fertility of hyperthermic cows.

DISCUSSION

The ability to synchronize the onset of estrus, and the time of breeding and calving correspondingly, offers potential economic and management benefits to dairy farmers. It increases the rate of genetic gain through the use of artificial insemination (AI) in genetically superior sires with high-accuracy expected progeny differences, increases milk production through advancement of the mean calving date, and reduces the percentage of non-pregnant cows at the end of the breeding season (Xu *et al.*, 1997).

Previous studies (Byerley *et al.*, 1987; Perry *et al.*, 1991) have demonstrated that heifers with multiple estrous cycles before the breeding season have an increased probability of becoming pregnant. The proportion of pubertal heifers at the start of the breeding season, however, can vary dramatically across herds (Lucy *et al.*, 2001; Lamb *et al.*, 2006) and is influenced by numerous factors, including age, weight, body condition, and breed (Wiltbank *et al.*, 1966; Short and Bellows, 1971; Varner *et al.*,1977). Several fixed-time AI (FTAI) protocols have been developed for beef heifers. FTAI pregnancy rates were similar between protocols. Although FTAI pregnancy rates were reduced in prepubertal heifers, within this subset of females the protocols of shorter duration (5dCO and PG-6d-CIDR) were as effective in prepubertal heifers as the longer protocol (14dCIDR-PG). This suggests an extended period of

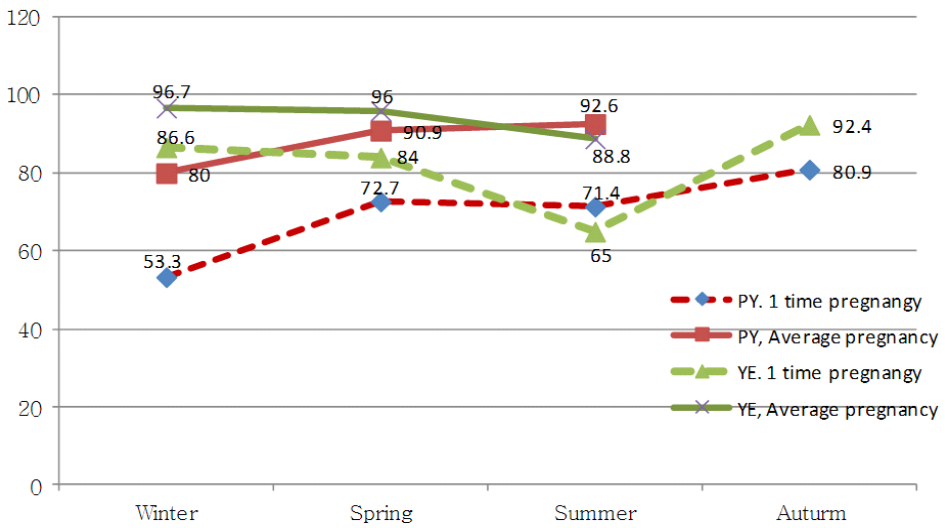

Fig. 5. One concept conception rates and repair rates, due to seasonal treatment estrus synchronization region.

progesterone exposure is not required to effectively synchronize ovulation in prepubertal heifers(Bridges *et al.*, 2014).

CONCLUSION

In summary, we suggest summer reproductive management to alleviate the effects of heat stress. It should be based on intensive cooling combined with hormonal treatment. Given that different subgroups of cows benefit differently from the treatments, selective hormonal administration should be considered.

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