University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1 (2025) PP 200-207

https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Impact of Timed Artificial Insemination within Presynchronization Protocol on Reproductive Performance in Dairy Cows

Mahmood Khudair Abass, Ismaeel Saad Kuridi, Omar Jassim Alhayany, Ahmed Ibrahem Alsuwaidawi

[1] Department of Surgery and Obstetrics, College of veterinary medicine, university of Fallujah, Al-Ramadi, Iraq.

[2] Department of Surgery and Obstetrics, College of veterinary medicine, university of Fallujah, Al-Ramadi, Iraq.

[3] Department of Pharmacology, Toxicology and Clinical, College of Pharmacology, university of Alma'arif, Al-Ramadi, Iraq.

[4] Department of Surgery and Obstetrics, College of veterinary medicine, university of Fallujah, Fallujah, Iraq.

Corresponding author : omar.j.mohammed@uoa.edu.iq

Abstract

The aims of this study were to compare of some reproductive performance after timed artificial insemination (TAI) or using artificial insemination (AI) at oestrus detected. Fifty anoestrus cows, selected between 75 and 100 days postpartum, were separated into two equal groups. The control group (n = 25) consisted of cows that received no treatment and underwent artificial insemination when the first postpartum oestrus was identified. The treated group (n = 25) of cows underwent the presynchronization protocol [Day 0 (GnRH); Day 7 (GnRH); Day 14 ($PGF_{2\alpha}$); Day 15 ($PGF_{2\alpha}$); Day 16 (GnRH); TAI 16-24 hours latter]. Trans-rectal ultrasonography confirmed the pregnancy on days 35-40 after insemination. The results of this study show pregnancy rate (PR) for the treated group was significantly higher than (P=0.04) to that of the control group (56% vs. 28%, respectively). Furthermore, mean days of days open (DO) and calving interval (CI) for the treated group (104 ±2.8 and 384 ±2.8, respectively) were significantly (P=0.001) shorter than those in the control group 156 ±17.3 and 436 ±17.3, respectively). In conclusion, using TAI within presynchronization protocol eliminate the requirement for oestrus detection and improve reproductive performance at first service in postpartum dairy cows.

Key words: Calving interval, Days Open, Pregnancy rate, Presynch, Timed Artificial Insemination

I. Introduction

The identification of oestrus is increasingly recognized as a significant challenge in dairy herds (Holman *et al.*, 2011). Cows show fewer oestrus behavioral signs, which are diminishing and pose challenges for farmers to identify cow in heat (Dobson *et al.*, 2007; Somers *et al.*, 2015). This decline in oestrus detection efficiency has led to lower pregnancy rates (PR), prolonged days open (DO), and calving interval (CI), consequently, economic losses; specifically, in dairy farms using artificial insemination (AI) techniques rely on visual observation method for oestrus detection for identifying cows in heat (Reith and Hoy, 2018).

Ovulation synchronization protocols (Ovsynch), which do not require oestrus monitoring, can be applied in farms with low oestrus detection rates. The aim of Ovulation synchronization is to initiate treatment early after calving, rather than waiting for cows to exhibit oestrus after the voluntary waiting period. These protocols enhance reproductive efficiency by synchronizing ovulation with prostaglandin F2 alpha ($PGF_{2\alpha}$) and gonadotropin-releasing hormone (GnRH), using Timed Artificial Insemination (TAI), cows are inseminated at fixed time without the need to observe their oestrus (Pursley, Mee and Wiltbank, 1995; Pursley *et al.*, 1997).

However, previous studies (Pursley and Martins, 2011; Carvalho, Wiltbank and Fricke, 2015) have shown that starting Ovsynch at a random point in the oestrus cycle leads to poor synchronisation of ovulation

University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1 (2025) PP 200-207

https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

on the day of TAI; consequently, decreased fertility outcomes**.** Other studies indicate that the Ovsynch protocol is most successful when performed between days 5 and 7 of the oestrous cycle in lactating dairy cows, one approach is to presynchronize the oestrous cycle (Stevenson, 2016; Mariol *et al.*, 2024).

Therefore, authors was developed many presynchronization methods that increase the effectiveness of TAI protocols. The main idea of presynchronization protocols that were developed based on presynchronization with $PGF_{2\alpha}$ such as Presynch-14 protocol (Moreira *et al.*, 2001) or presynchronization based on GnRH such as Double Ovsynch protocol (Souza *et al.*, 2008), was to synchronize cows' oestrous cycles to the early distrust phase before the Ovsynch protocol began (Cardoso Consentini, Wiltbank and Sartori, 2021).

This study was aimed to evaluate the efficiency of TAI within presynchronization program on some reproductive performance in postpartum local dairy cows at first service postpartum compared to AI at oestrus detection.

II. Materials and Methods

Study animals, housing and design

The study was conducted from Jan 2024 to Mar 2025. on private rural filed in Khalidiya and Ramadi cities, Anbar Province, Iraq. Postpartum anoestrus cows (n=50) were housed in free stalls barns and provided with clean, fresh water were milked twice daily. The cows were selected between 75–100 DIM at a ranges of parity (3-6), and weight (200-400 kg).

The control group (n = 25) untreated cows were monitored for oestrus signs (only cows being mounted) two times/day by farm owners (Figure 1). Cows observed in estrus in the AM received AI in the PM and vice versa. The Presynch group (n = 25) treated cows were subjected to ovarian ultrasound examination at first day treatment, to ensure the ovarian activity. After that, cows received treatments of GnRH [Busereline acetate (Gestar®),10.5 µg, 2.5 mL, Over, Argentina] and $PGF_{2\alpha}$ [Cloprostenol (Alfaglandin® C), 500 mcg, 2 mL, Alfasan, Holland] according to presynchronization scheduled (Figure 1).

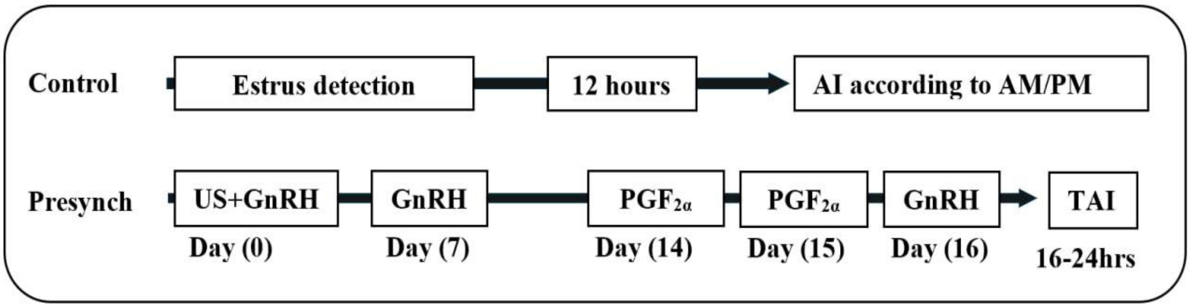

Figure 1: US (ultrasonography to confirm the presence of the follicles size ≥ 8 mm in diameter. Presynch protocol [Day 0 (GnRH); Day 7 (GnRH); Day 14 ($PGF_{2\alpha}$); Day 15 ($PGF_{2\alpha}$); Day 16 (GnRH)]. 16-24 hours latter TAI (timed artificial insemination)].

Reproductive parameters

The pregnancy rate (PR%) is defined as the number of pregnant cows following the first service / the total number of cows inseminated (x100). In this study, the calving date obtained by asking the breeders. The days open was the time from calving date to the date AI that result in confirmed pregnancy. The calving interval was obtained by adding the pregnancy period (280 days) to days open.

Ultrasound examination

The present study evaluated the ovarian status of treated cows on the initial day of treatment through trans rectal ultrasonography employing a 6.5-MHz linear probe to detect large follicles (≥8 mm) in diameter. The follicle diameter was measured using an electronic calliper based on the equation (follicle height + follicle width) / 2, as described by (Widodo *et al.*, 2022).

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1 (2025) PP 200-207

https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Pregnancy diagnosis was conducted between days 35 and 40 post-insemination for all cows using trans-rectal ultrasound with a 6.5-MHz linear probe. Pregnancy can be confirmed if an embryo with a heartbeat is seen or if there is clear fluid in the uterus along with a developed corpus luteum (CL) (Dixit and Haloi, 2022).

Statistical analysis

Study parameters' influence of several variables was found using the statistical analysis system (SAS, 2018) software. The chi-square test was used to evaluate changes in CR at 5% and 1% significant levels. Means were compared substantially using the least significant difference (LSD) approach.

Results and Discussion

Pregnancy rate (PR%)

In the present study, the untreated cows in control group which receive AI at first estrus detected using traditional observation method, achieved a first service PR of 28% (7/25) (Table 2, Figure 2). This result is consistent with previous findings that reported PR of 27.5%, 31% and 32% (Fricke *et al.*, 2014; Alsuwaidawi and Alrawi, 2023; Strickland *et al.*, 2024). Conversely, Keister (Keister *et al.*, 1999) and Lakher (Lakher *et al.*, 2019)was observed a lower PR of 15.9% and 16.6%, respectively.

In contrast, previous studies was achieved a higher findings of PR after using advanced tools for oestrus detection compared to the traditional method that used in this study. For instance, (Lauber and Fricke, 2024) reported a 43.5% PR for tail paint method. Another study by Jobst (SM, 2000) who was found a 45.6% PR for heat watch method. Variability in PR among studies may be attributed to differences in nutritional status, body condition score, reproductive status (e.g., cyclicity or anestrus), and estrus detection methods.

In the current study, cows treated with a presynchronization protocol followed by TAI exhibited a significantly higher PR of 56% (14/25) (Table 1, Figure 2). This outcome aligns with previous research reporting PR of 57% and 51.4% following TAI within the G6G and PG-3-G presynchronization protocols, respectively (Yousuf *et al.*, 2016; Kutlu and Dinç, 2020). These results surpass other studies where first-service PR of 33%, 40%, and 45% were achieved using different TAI strategies (Hubner *et al.*, 2020; Consentini *et al.*, 2022, 2025).

However, the current PR was lower than that reported by (Alsuwaidawi and Alrawi, 2024)who found a 65% PR at first service post-calving in cows treated with the PG+G protocol. The PG+G protocol involves the concurrent get of GnRH and $PGF_2\alpha$ seven days prior to initiating the Ovsynch regimen, potentially enhancing its efficacy in cyclic and non-cyclic cows (Martins *et al.*, 2017). Similarly, Oosthuizen (Oosthuizen *et al.*, 2025) demonstrated a PR of 60.9% in cows treated with a control internal drug release (CIDR) device combined with $PGF_2\alpha$ 7 days before beginning the CO-Synch protocol.

The observed differences in PR between studies can be attributed to the variation of synchronization protocol and hormone combinations, sample size, herd management practices, and the expertise of inseminators as well as cow-related factors (age, breed, parity).

Table 1: Comparison of first-service pregnancy rate between study groups.

Item	Groups		P-value
	Control (n=25)	Presynch (n=25)	
Pregnancy rate% (n/n)	28% (7/25)	56% (14/25)	P=0.04

There is a significant difference (P≤0.05) between groups in terms of pregnancy rate.

University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1 (2025) PP 200-207

https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

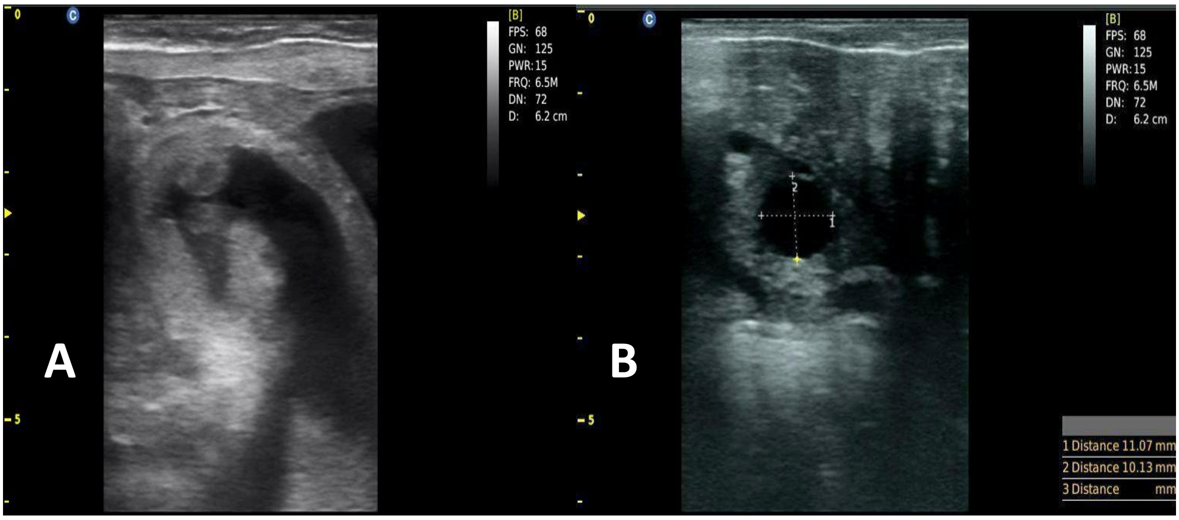

Figure 2: Ultrasound images show (A) 35-day-old embryo is contained in the uterine horn. (B) an ovary with a large follicle measuring 10.56 mm in diameter.

As shown in Table 1, the statistical analysis indicated a significant difference (P = 0.04) in first-service PR between the control group and the Presynch group, with rates of 28% and 56%, respectively. This observation aligns with previous research reporting significantly improved PR in presynchronized cows compared to untreated controls (Lauber and Fricke, 2024; Strickland *et al.*, 2024).

In contrast, previous studies have found no significant difference ($P \geq 0.05$) in pregnancy outcomes at 35 days post-insemination between TAI and estrus-based AI strategies (DeJarnette and Marshall, 2003; Rabiee, Lean and Stevenson, 2005). Furthermore, other authors have reported fertility outcomes for cows that receive AI at detected oestrus was higher ($P \leq 0.05$) PR compared to the TAI within classical Ovsynch regime (Cordoba and Fricke, 2002).

The results of this study suggested that low oestrus detection rates may be considered a primary factor contributing to lower fertility in the control group. It has been reported that the rate of oestrus detection with the traditional observation method did not reach 50% in the first and second lactation periods due to the low intensities and short durations of oestrus behaviour caused by increased milk production, which is associated with feed shortages and a negative energy balance (Bisinotto *et al.*, 2015).

The rise in fertility seen in the cows that received treatment might be due to TAI-based protocols eliminating the need for detecting oestrus. By synchronising ovulation and scheduling insemination at a fixed time, these protocols ensure a 100% service rate for all treated cows, thereby standardising breeding efficiency and reducing the labour and time investments associated with traditional oestrus observation(Fricke and Wiltbank, 2022).

Furthermore, all cows in the treated group were selected to be in the follicular phase of their oestrous cycle, exhibiting active ovaries (follicle size ≥ 8mm) on the initial day of treatment (Figure 2). According to Bello (NM, 2006), GnRH-based presynchronization protocols are reported to be more beneficial for cows in the follicular phase or those that are anovulatory at the time of treatment. Administering GnRH seven days before the Ovsynch procedure stimulates the release of LH and FSH, promoting ovulation and the initiation of a new follicular wave—essential aspects for achieving synchronisation success.

Moreover, presynchronization with GnRH generally establishes the ideal physiological conditions for starting the Ovsynch protocol, characterised by a functional CL with moderate serum progesterone levels (0.5–7 ng/mL) and a dominant follicle measuring 12–19 mm (Wiltbank and Pursley, 2014).

Calving interval (CI) and Days open (DO)

Calving interval (CI) and days open (DO) are critical reproductive performance metrics in dairy cattle management. CI, defined as the duration between two consecutive calvings in the same cow, comprises two essential components: the gestation period (approximately 280 days) and the open period (Temesgen *et al.*, 2022;

University of Thi-Qar Journal of agricultural research
Thi-Qar Journal of agricultural research
ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1 (2025) PP 200-207
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

Cakircali *et al.*, 2023). The open period is the time from parturition until successful conception and is highly influenced by postpartum reproductive physiology, including the anoestrus phase, ovarian cyclicity, and breeding management practices (Sari, Hartono and Suharyati, 2017).

According to industry benchmarks, ideal reproductive targets include a DO period ranging between 85–115 days and a CI of 365–395 days. These values are considered optimal for sustaining one calf per cow annually, a key goal for maximizing herd productivity and economic returns (Stevenson and Britt, 2017; Damiran *et al.*, 2018; Senbeta, Abebe and Gibe, 2024). Optimal reproductive performance is generally achieved when the first estrus is observed within 40 days postpartum, and the first service occurs after 60 days in healthy cows (Dinkissa and Guye, 2022).

In the current study, untreated control cows were inseminated at their first detected spontaneous estrus showed average CI and DO values of 436±17.3 and 156±17.3 days, respectively (Table 2). These values notably exceed the ideal ranges, indicating suboptimal reproductive performance. Similar elevated CI and DO values have been reported in various studies, respectively, 444.2 and 151 days (M'hamdi *et al.*, 2010), 665.1 and 199.8 days (Dinkissa and Guye, 2022), and 421 and 121 days (Alsuwaidawi and Alrawi, 2023).

Conversely, more favorable reproductive metrics have been documented. For instance, Sari (SARI, AYAŞ and SELVİ, 2025) reported a mean CI of 374.73 days and DO of 95.61 days in a broad survey involving 2,234 cows across 49 farms. Likewise, (Yılmaz and Sarıözkan, 2020) observed CI and DO values of 369.9 and 82.9 days, respectively, figures aligning well with the recommended targets. Teseuggesting the persistence of reproductive inefficiencies in multiple herds under diverse management conditions.

In this study, cows in the treatment groups exhibited average days of CI and DO was 348 and 104, respectively (Table 2). These values align closely with those reported by (Kutlu and Dinç, 2020)who observed 333 and 53 days in cows subjected to a presynchronization protocol. Moreover, the present results corroborate findings from local study evaluating different presynchronization protocols documented CI and DO values of 343 and 63 days, respectively (Alsuwaidawi and Alrawi, 2024).

The data analysis showed a significant difference (P = 0.001) in CI and DO between the control and treatment groups (Table 2). These findings confirm that the application of TAI within an ovulation synchronization protocol effectively improves reproductive performance, resulting in CI and DO values that fall within the desired industry benchmarks.

Table 2: Effects of TAI protocol on calving interval and days open in dairy cows.

Item	Groups		P-value
	Control	Presynch	
Days open	156 ± 17.3	104 ± 2.8	P=0.001
Calving interval	436 ± 17.3	384 ± 2.8	P=0.001

Values: mean days ± standard error. There is highly significant difference ($P\leq0.01$) between groups in terms of days open and calving interval.

The suboptimal reproductive performance observed in this study's control group may be attributed to various factors, including management factors such as inaccurate oestrus detection, substandard housing, hygiene conditions and inadequate nutritional support. Additional risk factors influencing CI and DO include parity, calf sex, body condition score (BCS), age at first conception, milk production levels, and the presence of postpartum disorders such as dystocia, metritis, and retained placenta, alongside seasonal heat stress (Hafilah and Solihati, 2024; Senbeta, Abebe and Gibe, 2024).

Moreover, the prolonged postpartum anoestrus period can delay breeding (which represents the interval from calving to the first observed oestrus), leading to an extended DO and negatively impacting CI and overall reproductive efficiency. This period is affected by several interrelated factors, including the duration required for complete uterine involution, the timely resumption of normal ovarian cyclicity, the occurrence of silent ovulations, and challenges in oestrus detection and insemination timing (SARI, AYAŞ and SELVİ, 2025).

Presynchronization protocols based on the strategic use of exogenous hormones (GnRH and $PGF_{2\alpha}$) can address many reproductive issues by promoting the resumption of ovarian activity, resolving postpartum disorders (e.g., anoestrus, anovulation, ovarian cysts), and mitigating the effects of environmental and physiological stressors, such as heat stress (Wiltbank and Pursley, 2014; Temesgen *et al.*, 2022).

Conclusion

Using TAI within presynchronization protocol significantly improved reproductive performance in postpartum dairy cows compared to estrus-based AI. These findings support the integration of TAI protocols into reproductive management strategies, particularly in herds with poor estrus detection efficiency.

Acknowledgements

We are grateful to the Deanship of the University of Fallujah College of Veterinary Medicine for providing all the necessary materials. We sincerely appreciate the Department of Surgery and Obstetrics head and staff at the College of Veterinary Medicine, University of Fallujah, for their invaluable assistance in carrying out this investigation.

Conflict of interest

The authors affirm that they have no conflicts of interest.

References

Alsuwaidawi, A. and Alrawi, H.M. (2023) 'Fertility of Postpartum Iraqi Cows Following Timed Artificial Insemination within Ovsynch or Presynch Protocols', *Al-Anbar Journal of Veterinary Sciences*, 16(2), pp. 62–72. Available at: https://doi.org/10.37940/ajvs.2023.16.2.7.

Alsuwaidawi, A.I. and Alrawi, H.M. (2024) 'Impact of three different ovulation synchronization protocols on first-service conception rates in postpartum cows', *Iraqi Journal of Veterinary Sciences*, 38(3), pp. 647–652. Available at: https://doi.org/10.33899/ijvs.2023.143884.3265.

Bisinotto, R.S. *et al.* (2015) 'Meta-analysis of progesterone supplementation during timed artificial insemination programs in dairy cows', *Journal of Dairy Science*, 98(4), pp. 2472–2487.

Cakircali, R. *et al.* (2023) 'Effects of daily propylene glycol drenching during the Ovsynch protocol on fertility and metabolic parameters in lactating dairy cows', *Reproduction in Domestic Animals*, 58(8), pp. 1097–1103.

Cardoso Consentini, C.E., Wiltbank, M.C. and Sartori, R. (2021) 'Factors that optimize reproductive efficiency in dairy herds with an emphasis on timed artificial insemination programs', *Animals*, 11(2), p. 301.

Carvalho, P.D., Wiltbank, M.C. and Fricke, P.M. (2015) 'Manipulation of progesterone to increase ovulatory response to the first GnRH treatment of an Ovsynch protocol in lactating dairy cows receiving first timed artificial insemination', *Journal of dairy science*, 98(12), pp. 8800–8813.

Consentini, C.E.C. *et al.* (2022) '(TO BE SUBMITTED FOR JOURNAL OF DAIRY SCIENCE): FERTILITY PROGRAMS FOR LACTATING DAIRY COWS: A NOVEL PRESYNCH+ TIMED AI PROGRAM (DOUBLE E-SYNCH) PRODUCES SIMILAR OVARIAN DYNAMICS, SYNCHRONIZATION, AND FERTILITY AS DOUBLE-OVSYNCH', *"Luiz de Queiroz" College of Agriculture*, p. 65.

Consentini, C.E.C. *et al.* (2025) 'Reproductive outcomes of lactating dairy cows submitted to first timed artificial insemination protocols with different strategies to induce final ovulation', *Journal of Dairy Science*, 108(1), pp. 1138–1149.

Cordoba, M.C. and Fricke, P.M. (2002) 'Initiation of the breeding season in a grazing-based dairy by synchronization of ovulation', *Journal of Dairy science*, 85(7), pp. 1752–1763.

Damiran, D. *et al.* (2018) 'Effect of calving period on beef cow longevity and lifetime productivity in western Canada', *Translational Animal Science*, 2(suppl_1), pp. S61–S65.

DeJarnette, J.M. and Marshall, C.E. (2003) 'Effects of pre-synchronization using combinations PGF2α and (or) GnRH on pregnancy rates of Ovsynch-and Cosynch-treated lactating Holstein cows', *Animal reproduction science*, 77(1–2), pp. 51–60.

Dinkissa, A.F. and Guye, M.E. (2022) 'Review on Dairy Cattle Reproductive Performance Under Different Production System in Ethiopia', *American Journal of Food Science and Technology*, 1(1), pp. 1–9. Available at: https://doi.org/10.54536/ajfst.v1i1.407.

Dixit, C.P. and Haloi, S. (2022) 'Clinical application of ultrasound in bovine reproduction: A review', *Pharma Innov*, 11, pp. 1311–1314.

Dobson, H. *et al.* (2007) 'The high-producing dairy cow and its reproductive performance', *Reproduction in domestic animals*, 42, pp. 17–23.

Fricke, P.M. *et al.* (2014) 'Reproductive performance of lactating dairy cows managed for first service using timed artificial insemination with or without detection of estrus using an activity-monitoring system', *Journal of Dairy Science*, 97(5), pp. 2771–2781.

Fricke, P.M. and Wiltbank, M.C. (2022) 'Symposium review: The implications of spontaneous versus synchronized ovulations on the reproductive performance of lactating dairy cows', *Journal of dairy science*, 105(5), pp. 4679–4689.

Hafilah, I. and Solihati, N. (2024) 'THE RELATIONSHIP BETWEEN PARITY TO PLACENTAL RETENTION AND THE IMPACT ON DAYS OPEN AND CALVING HUBUNGAN PARITAS DENGAN RETENSI PLASENTA DAN DAMPAK PADA DAYS OPEN (MASA KOSONG) DAN CALVING INTERVAL (JARAK BERANAK) PADA SAPI PERAH DI KPSBU LEMBANG', 24(1), pp. 109–116. Available at: https://doi.org/10.24198/jit.v24i1.54679.

Holman, A. *et al.* (2011) 'Comparison of oestrus detection methods in dairy cattle', *Veterinary Record*, 169(2), p. 47.

Hubner, A.M. *et al.* (2020) 'Effect of GnRH 7 days before presynchronization with simultaneous PGF2α and GnRH on reproductive outcomes in Holstein dairy cows', *Frontiers in Veterinary Science*, 7, p. 574516.

Keister, Z.O. *et al.* (1999) 'Pregnancy outcomes in two commercial dairy herds following hormonal scheduling programs', *Theriogenology*, 51(8), pp. 1587–1596.

Kutlu, M. and Dinç, D.A. (2020) 'Comparison of the effects of two pre-synchronization protocols (G6G and PG-3-G) on some reproductive performance parameters in Holstein cows.', *Eurasian Journal of Veterinary Sciences*, 36(4).

Lakher, J.P. *et al.* (2019) 'Efficacy of Ovsynch and Ovsynch Plus Protocol for Improvement of Fertility in Postpartum Sahiwal Cows.', *Indian Journal of Veterinary Sciences & Biotechnology*, 14(4).

Lauber, M.R. and Fricke, P.M. (2024) 'Effect of postpartum body condition score change on the pregnancy outcomes of lactating Jersey cows inseminated at first service with sexed Jersey or conventional beef semen after a synchronized estrus versus a synchronized ovulation', *Journal of Dairy Science*, 107(4), pp. 2524–2542.

M'hamdi, N. *et al.* (2010) 'Phenotypic and genetic parameters of reproductive traits in Tunisian Holstein cows', *Biotechnology in Animal Husbandry*, 26(5–6), pp. 297–307.

Mariol, N.M. *et al.* (2024) 'Impact of presynchronization and Ovsynch on early postpartum ovarian activity and fertility of dairy cows in Libya', *Open Veterinary Journal*, 14(3), p. 822.

Martins, J.P.N. *et al.* (2017) 'The effect of presynchronization with prostaglandin F2α and gonadotropin-releasing hormone simultaneously, 7 d before Ovsynch, compared with Presynch-10/Ovsynch on luteal function and first-service pregnancies per artificial insemination', *Journal of Dairy Science*, 100(6), pp. 5107–5116.

Moreira, F. *et al.* (2001) 'Effects of presynchronization and bovine somatotropin on pregnancy rates to a timed artificial insemination protocol in lactating dairy cows', *Journal of dairy science*, 84(7), pp. 1646–1659.

NM, B. (2006) 'Optimizing ovulation to first GnRH improved outcomes to each hormonal injection of ovsynch in lactating dairy cows', *J Dairy Sci*, 89, pp. 3413–3424.

Oosthuizen, N. *et al.* (2025) 'Comparison of different GnRH compounds on fertility outcomes in ovulation synchronized and presynchronized beef cows', *Frontiers in Animal Science*, 6, p. 1502984.

Pursley, J.R. *et al.* (1997) 'Pregnancy rates per artificial insemination for cows and heifers inseminated at a synchronized ovulation or synchronized estrus', *Journal of dairy science*, 80(2), pp. 295–300.

Pursley, J.R. and Martins, J.P.N. (2011) 'Impact of circulating concentrations of progesterone and antral age of the ovulatory follicle on fertility of high-producing lactating dairy cows', *Reproduction, Fertility and Development*, 24(1), pp. 267–271.

Pursley, J.R., Mee, M.O. and Wiltbank, M.C. (1995) 'Synchronization of ovulation in dairy cows using PGF2α and GnRH', *Theriogenology*, 44(7), pp. 915–923.

Rabiee, A.R., Lean, I.J. and Stevenson, M.A. (2005) 'Efficacy of Ovsynch program on reproductive performance in dairy cattle: A meta-analysis', *Journal of dairy science*, 88(8), pp. 2754–2770.

Reith, S. and Hoy, S. (2018) 'Behavioral signs of estrus and the potential of fully automated systems for detection of estrus in dairy cattle', *Animal*, 12(2), pp. 398–407.

SARI, A., AYAŞ, R. and SELVİ, M.H. (2025) 'Evaluation of Fertility Parameters and Nutrition-Fertility Relationship in Dairy Cattle Farms in Ereğli District of Konya Province', *Evaluation*, 2(1).

Sari, E.C., Hartono, M. and Suharyati, S. (2017) 'Faktor-faktor yang memengaruhi service per conception sapi perah pada peternakan rakyat di Provinsi Lampung', *Jurnal Ilmiah Peternakan Terpadu*, 4(4).

Senbeta, E.K., Abebe, A.S. and Gibe, A.W. (2024) 'Effect of parity on service per conception, gestation length, milk yield, calving interval, and calf birth weight of crossbred dairy cows.', *Archives of Veterinary Science*, 29(2).

SM, J. (2000) 'Evaluation of reproductive performance in lactating dairy cows with prostaglandin PGF_< 2α>, gonadotropin-releasing hormone, and timed artificial insemination', *J Dairy Sci*, 83, pp. 2366–2372.

Somers, J.R. *et al.* (2015) 'The effect of lameness before and during the breeding season on fertility in 10 pasture-

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1 (2025) PP 200-207
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323

based Irish dairy herds', *Irish Veterinary Journal*, 68, pp. 1–7.

Souza, A.H. *et al.* (2008) 'A new presynchronization system (Double-Ovsynch) increases fertility at first postpartum timed AI in lactating dairy cows', *Theriogenology*, 70(2), pp. 208–215.

Stevenson, J.S. (2016) 'Physiological predictors of ovulation and pregnancy risk in a fixed-time artificial insemination program', *Journal of Dairy Science*, 99(12), pp. 10077–10092.

Stevenson, J.S. and Britt, J.H. (2017) 'A 100-Year Review: Practical female reproductive management', *Journal of dairy science*, 100(12), pp. 10292–10313.

Strickland, J.M. *et al.* (2024) 'When Implementing the Presynch-11/Ovsynch Reproductive Management Program, the Fertility of Lactating Dairy Cows Improved When They Received Timed Artificial Insemination Compared with the Inclusion of Estrus Detection', *Animals*, 14(15), p. 2235.

Temesgen, M.Y. *et al.* (2022) 'Factors affecting calving to conception interval (days open) in dairy cows located at Dessie and Kombolcha towns, Ethiopia', *PloS one*, 17(2), p. e0264029.

Widodo, O.S. *et al.* (2022) 'Relationship between ovary size and anti-müllerian hormone levels in Holstein–Friesian cows', *Frontiers in Veterinary Science*, 9, p. 828123.

Wiltbank, M.C. and Pursley, J.R. (2014) 'The cow as an induced ovulator: Timed AI after synchronization of ovulation', *Theriogenology*, 81(1), pp. 170–185.

Yılmaz, H. and Sarıözkan, S. (2020) 'Kayseri ili Yahyalı ilçesi süt sığırcılık işletmelerinde suni tohumlama uygulamaları ve başarıyı etkileyen faktörler', *Erciyes Üniversitesi Veteriner Fakültesi Dergisi*, 17(2), pp. 95–102.

Yousuf, M.R. *et al.* (2016) 'Presynchronization of lactating dairy cows with PGF2α and GnRH simultaneously, 7 days before Ovsynch have similar outcomes compared to G6G', *Theriogenology*, 86(6), pp. 1607–1614.

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 14, Issue 1 (2025) PP 200-207
https://jam.utq.edu.iq/index.php/main https://doi.org/10.54174/utjagr.v13i1.323