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Animal Production

Assessment of the Reproductive Performance of a Holstein Dairy Herd as affected by the Efficiency of the Inseminator

Mohamed J. Al-Hassan
Department of Animal Production College of Agriculture, King Saud University
P.O. Box 2460, Riyadh 11451, Saudi Arabia

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Abstract. A commercial dairy farm in the central region of Saudi Arabia was evaluated for overall reproductive performance and inseminator's effect. Average days to first service and average days open were 70 and 105, respectively. Heat detection rate was low (61%) and first service conception rate average was (51%), while second and third service conception rates were precipitously lower, 38 and 14% respectively. Overall conception rate was 74% and an average service/conception ratio was 2.5. There were no significant inseminator effect regarding interestrous interval, pregnancy rate and number of services per conception. However, pregnant cow's average days open was significantly higher for cows inseminated by one inseminator (86.76 days) than cows inseminated by second inseminator (77.41 days). These results indicate that the reproductive performance of the herd as a whole can be improved by increasing heat detection rate.

Introduction

Reproductive performance indices are an important measure of the cow's ability to conceive and produce a viable offspring. This is one of the major factors influencing the efficiency of milk production, the number of calves produced per cow and lifetime milk production [1]. Some of the important factors that affect reproductive performance are heat detection, which is reflected by days to first insemination, number of inseminations (services) per pregnancy, interestrous interval and calving interval. Heat detection accuracy is vital for high milk production, since inaccurate heat detection leads to increased days open, and consequently, economic loss for milk producers [2]. Heat detection becomes more important with the use of artificial insemination (AI), which is greatly influenced by early heat detection [3, 4, 5].

The site of semen deposition is also critical for successful AI in cattle [6] while adequate and proper training of AI technicians improves inseminator performance [7]. Most training techniques for inseminators involve semen deposition into the reproductive tracts excised from cows. Research involving placement of semen in the

reproductive tract of the cow indicates that attempts to correctly position the insemination rod tip and deliver the semen into the uterine body have been unpredictable and difficult to achieve [8-10].

It has been recognized that many inseminators are unable to inseminate cows correctly, and that conception rate in cows differ widely between inseminators [6]. In an attempt to improve the method of inseminators' training, researchers [11] developed an ultrasound method for determining the site of simulated semen deposition in live cows. In certain farms where herdsmen are involved in the process of inseminating cows, first service conception rate variations were noticed. Researchers reported a marked difference in the performance of herdsmen-inseminators. In one study [12], the highest herdsmen-inseminator achieved 63% first service conception while the lowest herdsmen inseminator achieved only 39% first service conception as determined by rectal palpation 35-45 days post insemination.

The objectives of this study are (i) to assess the overall reproductive performance of a dairy herd of Friesian Holstein cows in a local dairy farm, and (ii) to evaluate the effect of inseminator on reproductive performance of the herd.

Materials and Methods

The study was undertaken in a large dairy farm in the central region of Saudi Arabia during 1997-1998. All cows in the farm were Holstein cows. To ease heat stress during summer months, adequate shade was provided, and an evaporative cooling system was installed. All cows were fed according to the National Research Council (NRC) [13, pp 35-90] recommendations for pregnant and nonpregnant cows. Artificial insemination (AI) was performed by professional veterinarians working at the farm. Cows were observed 24 hours a day for heat by workers who, beside heat detection, had been assigned other tasks such as assisting cows in labor. All cows in the study herd were inseminated following first post-parturient heat regardless of postpartum interval, and there were no records for postpartum first heat. Cows were inseminated 12 hours after detection of standing heat. For the present experiment, the cows were assigned randomly to each of two inseminators. The total number of cows included in the experiment was 376 cows. Inseminator number 1 inseminated 155 cows, and inseminator number 2 inseminated 221 cows. All data in records were collected biweekly and analyzed, incomplete records being excluded. Cows were rectally palpated at 35-45 days post-insemination to confirm pregnancy. Data were statistically analyzed using the GLM procedure of Statistical Analysis System [14, pp 433-506] to determine the effect of inseminator on the reproductive parameters.

Results and Discussion

Herd reproductive performance:

Table 1-3 show the parameters used to analyze reproductive performance in the herd. As can be seen from table 1, even with 24 hour watching for cows in heat, heat detection rate in the farm was low (61%). This was no surprise; however, as observers

were assigned other tasks beside watching cows for heat, such as attending to cows in labor, providing care for sick animals and dealing with a host of other problems in the herd. Furthermore, the number of cows was high and the observer could not be in the right place at the right time. While heat detection is considered a cornerstone of any dairy farm operation, many farms fail to detect a high percentage of cows in heat. As a result of heat detection deficiency, reproductive performance is negatively affected. Previous reports have shown a high correlation between days open and milk production [15] and between days open and heat detection rate, thereby indicating that poor heat detection affects significantly the reproductive performance of cows, resulting in increased days open followed by increased calving interval [16,17]. The low heat detection rate prolongation of days open [2] have significant impact on the milk production and economic return. The problem of heat detection is not uncommon; it is estimated that farmers discover only 60% of cows that were in heat [3]. In fact, there are problems related to misinterpretation of behavioral signs of heat that result in insemination of 10-26% of cows during the luteal phase of the estrous cycle when conception is unlikely [18]. Other studies indicate that of all heats observed, up to 40% are not true standing heats [19]. Because of low heat detection rate, the average interestrous interval was a little higher in this present herd (34.75 ± 1.23) than the desirable limit, which is <30 days.

Table 1. Reproductive performance as revealed by data analysis of the dairy herd

Measure of performance	Farm*	Goal#
Average days to first service	70.33 ± 1.05	70-75
Average days open (pregnant cows)	79.65 ± 1.05	90-110
Average days open (all cows)	105 ± 2.59	< 120
Average interestrous interval	34.75 ± 1.23	< 30
Heat detection rate	61%	> 75%
First service pregnancy rate	51%	50%
Second service pregnancy rate	38%	50%
Third service pregnancy rate	14%	50%
Overall conception rate (up to 7 services)	74%	85%
Number of services/conception	2.50 ± 0.11	< 2.25

* Values represent Least-Square means with ± SEM.
# Upham, 1991.

Table 2. Comparison between 3 inseminations and more regarding conception rate

Criteria	Up to 3 services*	More than 3 services*	Total
Services per conception	1.56 [a]	4.6 [b]	2.50
Pregnant cows (n)	278	1	279
Open cows (n)	63	34	97
Average pregnancy Rate	82% [a]	3% [b]	74%
Average days open	96.7 [a]	183.2 [b]	105
Total number of cows	341	35	376

* Means within a row with different postscript are different ($p < 0.001$).

Normally, conception rate should be around 50% at each service [20, 21]. Many producers, however, feel their cows do not conceive, implying a conception rate problem. With an average of 50% conception rate, 50% of the cows need to be bred

twice per conception, 25% need to be bred three times, 12.5% need to be bred four times and so on, with a total of 87% conception rate after the third insemination. First service conception rate in the present herd was 51% (Table 1), second was 38% and third was 14%, thus reflecting a problem. The overall conception rate was 74% which maybe acceptable by most farms provided that services per cow did not exceed three inseminations [20]. In the present herd, however, this rate was not acceptable (74%) because it required more than three inseminations (up to 7 inseminations per cow).

On the other hand, while acceptable average number of services/conception should be less than 2.25 services [24]; the present results, showed a higher average of 2.50 services per conception. It is worth noting, however, that 35 cows received an average of 4.6 services per cow, yet only one of them conceived (Table 2) thereby significantly affecting the overall results. The average number of services per cow for the rest of the cows (341 cows) was 1.57 services with an 82% conception rate (Table 2). This is an indication of the presence of cows that had difficulty conceiving representing around 9% of the herd. These cows were responsible for a major cost to the producer for keeping them open for an average period of 183 days postpartum (Table 2).

Table 3. Comparison between pregnant and nonpregnant cows in certain criteria

Criteria	Open*	Pregnant*
Number of cows	97	279
Parity	2.86 ± 0.14	2.69 ± 0.83
Average days to first service	72.60 ± 2.08	69.56 ± 1.21
Average interestrous interval	39.56 ± 1.74 [a]	29.65 ± 1.79 [b]
Average number of services/cow	3.25 ± 0.08 [a]	1.37 ± 0.05 [b]

Values represent Least-Square means with ± SEM.
* Means within a row with different postscript are different ($p < 0.001$).

Results in Table 3 show that open cows in the herd represent 26% of the herd; this is high, considering that average postpartum days open for these cows was 176.86 days. There was no difference in parity between open and pregnant cows. Older cows are known to have lower conception rate in comparison to younger ones [22]. Not just regarding fertility per se, but also older cows are more prone to uterine infection, due to decreased ability to fight infection with advanced age. In addition, parity influences ovarian cysts occurrences. There is a much greater occurrence of ovarian cysts in mature cattle (39% incidence) than first calf heifers (11% incidence) [26]. Average days to first service were not different between open and pregnant cows. This was expected since all cows were raised under similar conditions, and within the same age group. However, interestrous interval was significantly different (39.56 ± 1.74 vs. 29.65 ± 1.79) indicating that open cows had greater interestrous intervals. Several reproductive problems can cause such as prolonged estrus, delayed ovulation, cystic ovarian degeneration or early embryonic death, abnormal interestrous interval [23]. Those open cows had received on average 3.25 services and were still open after 178 days postpartum. Although detailed data concerning the open cows in this present herd are not available, it is evident that open cows that do not conceive for that much of time are economically expensive to keep. We can only speculate on the causes of these cows

being not pregnant: they might have had uterine problems, or that difficult birth had resulted in retained placenta and as a consequence, the cows had difficulty conceiving.

Effect of inseminator on herd reproductive performance

As previously stated, the number of cows inseminated by inseminator number 1 and those by inseminator number 2 were 155 and 221 cows, respectively. Figure 1 shows that interestrous interval was not affected by inseminator ($p = 0.85$) although it was above average for both groups (> 34 days); ideally, this interval should have been below 30 days [24], and as mentioned earlier, many factors might have been responsible for this extending the average interestrous interval.

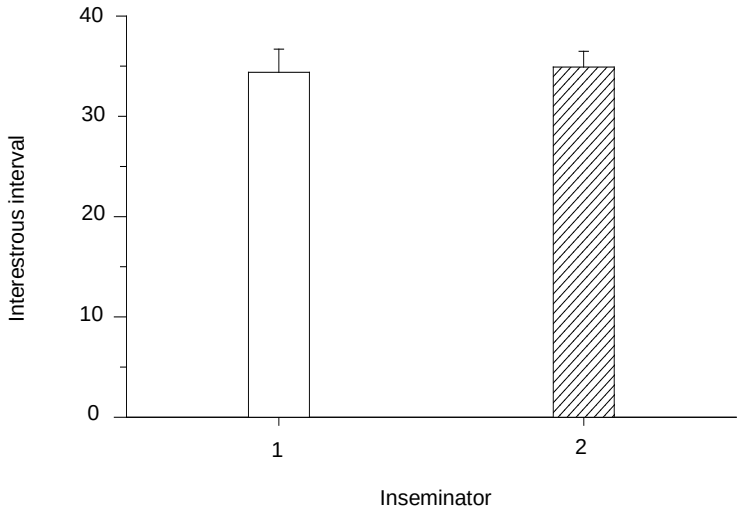

Fig 1. Effect of inseminator on interestrous interval (days). Differences were not significant between the two groups of cows.

Optimum conception rate occurs when inseminators detect heat early and accurately, handle semen correctly and deposit the semen in the proper site in the genital tract at the right time. That is why the inseminator performance is of great importance when compared to other variables such as herd nutrition, season and semen quality. It is critical to monitor conception rate for each inseminator on a monthly basis, so that poor performance can be identified and corrected. The difference in overall conception rate for each inseminator in the present study was limited ($p = 0.18$), although conception rate tended to be lower for inseminator 1 (69%) vs. inseminator 2, (75%) (Fig. 2). As a whole, conception rate after three or more inseminations for both inseminators was low since many cows were inseminated more than three times. The average number of services per conception was the same (2.5 services/conception) for both inseminators (Figure 3), indicating that both inseminators were of similar qualification and

experience. However, average days open for pregnant cows was significantly higher (Fig. 4) for cows inseminated by inseminator 1 (86.76 ± 3.27) than those inseminated by inseminator 2 (77.41 ± 1.84). As mentioned earlier [15, 16], there is a high correlation between average days open and heat detection rate, and poor heat detection leads to increased calving interval.

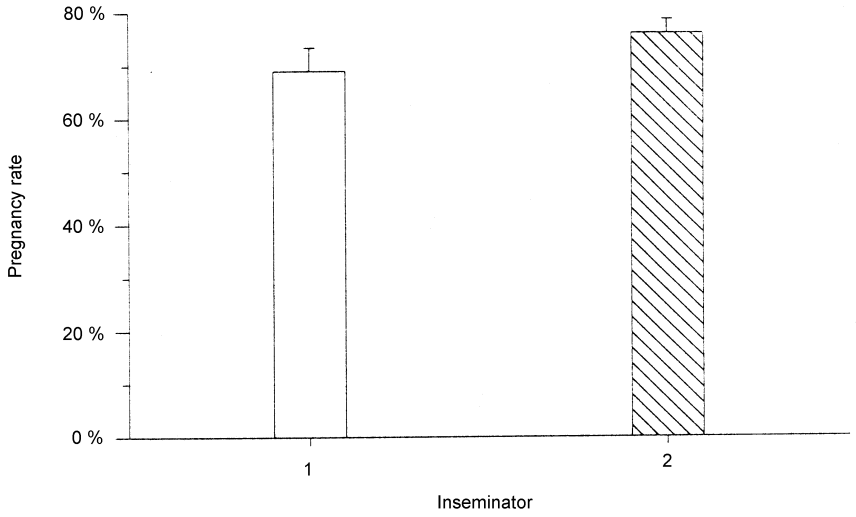

Fig 2. Effect of inseminator on pregnancy rate. Differences were not significant between the two groups of cows eventhough, pregnancy rate in group two tended to be higher than in group one (75 % vs. 69%).

Good dairy herd management should always include some type of regular monitoring to assess the reproductive performance of the herd. This should include efficiency of heat detection, a limiting factor to successful artificial insemination programs. Regardless of the method used, it will only provide useful information if accurate records are maintained and sound decisions implemented.

In conclusion, the reproductive performance of the herd studied was below average regarding heat detection rate, second service conception rate, third service conception rate and overall conception rate. To correct this defect, heat detection rate must be optimized. Another option is to develop a program that does not rely on heat detection, such as Ovsynch program [25] that relies on gonadotropin releasing hormone (GnRH) treatment and $PGF_{2\alpha}$ and insemination at a definite time without heat detection. While the role of the inseminator cannot be overemphasized, the data show that little differences in reproductive performance between the two groups of cows inseminated by the two inseminators.

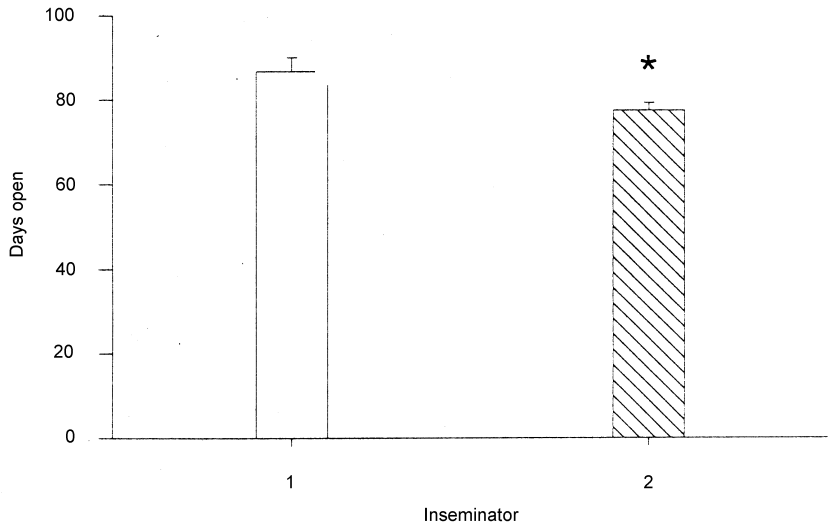

Fig. 3. Effect of inseminator on number of services per conception. There were not significant differences between the two groups of cows. Average number of services per conception was 2.5 services in each group.

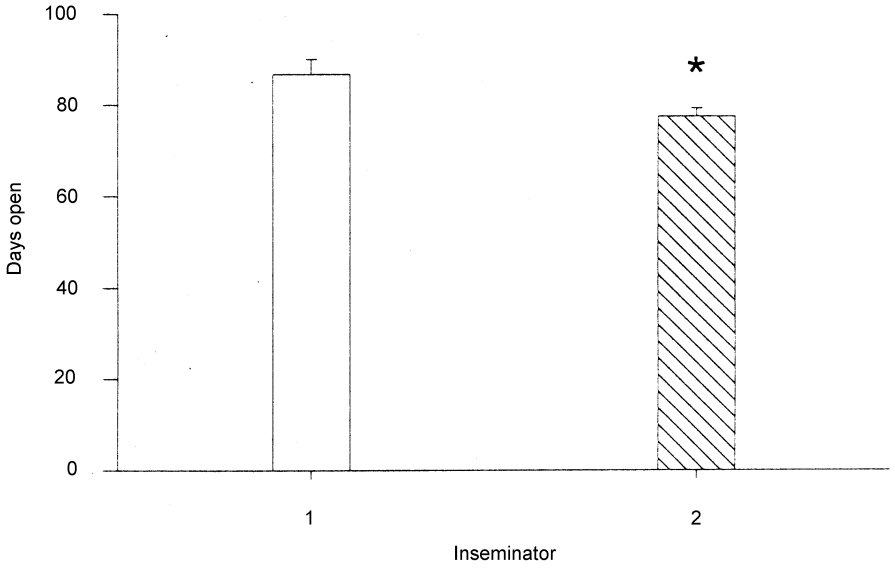

Fig 4. Effect of inseminator on average days open. * indicates a significant effect (p <0.01) of inseminator where cows inseminated by inseminator one had longer days open than their encounter parts inseminated by inseminator two (86 vs. 77 days).

References

[1] Esselemont, R.J. "Measuring Dairy Herd Fertility". *Veterinary Record*, 131 (1992), 209-212.

[2] Britt, J.H., Scott, R.G., Armstrong, J.D. and Whitcare, M.D. "Determinants of Estrous Behavior in Lactating Holstein Cow". *Journal of Dairy Science*, 69 (1986), 2195-2202.

[3] Esslemont, R.J. and Bryant, M.J. "Oestrous Behavior in a Herd of Dairy Cows". *The Veterinary Record*, 99 (1976), 472-475.

[4] Kiddy, C.A."Variation in Physical Activities as an Indication of Estrus in Dairy Cows". *Journal of Dairy Science*, 60 (1977), 235-243.

[5] Hurnik, J.F., and King, G.J. "Estrous Behavior in Confined Beef Cows". *Journal Animal Science*, 65 (1987), 431-438.

[6] Macpherson, J.W. "Semen Placement Effects on Fertility in Bovines". *Journal of Dairy Science*, 51 (1968), 807-811.

[7] Cembrowics, H. J. "Efficiency of Inseminators". *Proc. 5th Int. Congr. Anim. Reprod. Artif. Insem.* 4 (1964), 624-629.

[8] Graham, E.F. "The Use of a Dye Indicator for Testing, Training, and Evaluating Technicians in Artificial Insemination". *Proc. 1st Tech. Conf. Artif. Insem. Bovine Reprod.*, (1966), 57-60.

[9] Webb, J.H. "Use of Dye for Technician Training and Retraining". *Proc. 6th. Tech. Conf. on A.I. and Reprod*., (1976), 69-72.

[10] Peters, J.L., Senger, P.L., Rosenberger, J.L. and O'Connor, M.L. "Radiographic Evaluation of bBvine Artificial Inseminating Technique among Professional and Herdsman-inseminators Using 0.5 and 0.25 ml French Straws". *Journal of Animal Science*, 59 (1984), 1671-1683.

[11] Beal, W.E., Edwards III, R.B. and Kearnan, J.M. "Use of B-mode Linear Array Ultrasonography for Evaluating the Technique of Bovine Artificial Insemination". *Journal of Dairy Science*, 72 (1989), 2198-2202.

[12] Senger, P.L. "Effects of Serum Treated Semen, Bulls and Herdsmen Inseminators on Conception to First Service in Large Commercial Dairy Herds". *Journal of Dairy Science*, 67 (1984), 686-692.

[13] National Research Council. *Nutrition Requirements of Dairy Cattle* (6th revised ed.). Washington, D.C.: National Academic Press, 1989.

[14] SAS Institute Inc., SAS/STAT. 1989. *User's Guide Version 6*, 4th. ed., Vol. 2. Cary, NC: SAS Institute Inc., 1989.

[15] Louca, A. and Legates J.E. "Production Losses in Dairy Cattle Due to Days Open". *Journal of Dairy Science*, 51 (1968), 573-581.

[16] Barr, H.L. "Influence of Estrus Detection on Days Open in Dairy Herds". *Journal of Dairy Science*, 58 (1974), 246-247.

[17] Britt, J.H. "Enhanced Reproduction and Its Economic Implications". *Journal of Dairy Science*, 68 (1985), 1585-1592.

[18] Gunzler,O., Gortach, A., Hahn, R., Hocke, P., Claus, R. and Karg, H. "Milk Progesterone Determination as Applied to the Confirmation of Oestrus, the Detection of Cycling and as an Aid to Veterinarian and Biotechnical Measures in Cows". *British Veterinary Journal*, 135 (1979), 541-549.

[19] Rimers, T.J., Smith, R.D. and Newman, S.K. "Management Factors Affecting Reproductive Performance of Dairy Cows in the Northeastern United States". *Journal of Dairy Science*, 68 (1985), 963-972.

[20] Pennington, J.A., Hill, D.L., Callahan, C.J., Brown, C.M. and Brown M.D. "Effect of Preinsemination Injection of Gonadotropin-releasing Hormone on Reproductive Performance of Dairy Cattle". *The Bovine Practitioner*, 20 (1985), 14-16.

[21] Roy, L.A. "What Causes Cows to Repeat?" *Dairy Herd Management*, 23 (1985), 11-12.

[22] Gwasdauskas, F.C., Whittier, W.D., Vinson, W.E. and Pearson, R.E. "Evaluation of Reproductive Efficiency of Dairy Cattle with Emphasis on Timing of Breeding." *Journal of Dairy Science*, 69 (1986), 290-297.

[23] Gaines, J.D., Thomas, C.B. and Eicker, S. "The Interestrous Interval Profile of a Dairy Herd." How Useful is it? " *Veterinary Medicine*, 88 (1993), 665-671.

[24] Upham, G.L. "Measuring Dairy Herd Reproductive Performance". *The Bovine Practitioner*, 26 (1991), 49-56.

[25] Pursley, J.R., Wiltbank, M.C., Stevenson J.S., Ottobre, J.S., Garverick, H.A. and Anderson, L.L. “Pregnancy Rates per Artificial Insemination for Cows and Heifers Inseminated at a Synchronized Ovulation or Synchronized Estrus”. *Journal of Dairy Science,* 80 (1997), 295-300.

[26] Allrich, R.D. "Ovarian Cysts in Dairy Cattle.” Cooperative Extension Service, Purdue University, AS-451, (1991).

تأثير فني التلقيح على الكفاءة التناسلية لقطيع من بقر الفريزيان في المملكة العربية السعودية

محمد جعفر آل حسن

قسم الإنتاج الحيواني، كلية الزراعة، جامعة الملك سعود، المملكة العربية السعودية

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ملخص البحث. تم تقييم الكفاءة التناسلية وتقيم كفاءة الفني المسؤول عن التلقيح الصناعي في مزرعة تجارية لإنتاج اللبن في المنطقة الوسطى بالمملكة العربية السعودية. يتضح من نتائج البحث وجود إمكانية لتحسين الكفاءة التناسلية للقطيع، حيث إن معدل الأيام حتى عملية التلقيح الأولى كانت حوالي ٧٠ يوماً، و معدل الأيام حتى الحمل هو ١٠٥ أيام. وقد وجد أن نسبة اكتشاف الشبق منخفضة (٦١**%**) رغم أن نسبة الخصوبة مقبولة بعد عملية التلقيح الأولى (٥١**%**)، إلاّ أنها انخفضت بعد عملية التلقيح الثانية لتصل إلى (٣٨**%**) و الثالثة لتصل إلى (١٤**%**). كما وصلت نسبة الخصوبة الكلية للقطيع إلى ٧٤**%** فقط و عدد التلقيحات اللازمة لكل حمل هي ٢,٥ تلقيحة. لم يوجد فرق معنوي لفترة ما بين الشبق باختلاف الملقحين، ولا في نسبة الخصوبة أو عدد التلقيحات اللازمة لكل حمل. بينما وجدت فروق معنوية بين معدل الأيام حتى عملية التلقيح الأولى بين مجموعة البقر الأولى والثانية الملقّحة صنعياً بواسطة الملقح الأول والثاني، على التوالي، فكانت في المجموعة الأولى ٧٤ يوماً مقارنة بـ ٦٨ يوماً في المجموعة الثانية. كذلك فإن معدل الأيام حتى الحمل كانت مختلفة معنوياً في المجموعة الأولى (٨٦ يوماً) عن المجموعة الثانية (٧٧ يوماً). خلاصة النتائج هي عدم وجود تفاوت كبير بين مستوى الشخصين الملقحين حيث كانت نسبة الحمل متقاربة في المجموعتين اللتين قاما بتلقيحهما صنعياً. وتشير النتائج إلى إمكانية تحسين أداء القطيع عامةً بتحسين نسبة اكتشاف الشبق لما لها من نتائج على الكفاءة التناسلية العامة للقطيع.