SUCCESSFUL ARTIFICIAL INSEMINATION MANAGEMENT
Successful Artificial Insemination Management is the thirteenth in a series of management manuals published by Veepro Holland. Through these manuals Veepro Holland aims at providing you with useful management information. Dairy cattle worldwide have to be managed well to be able to utilize their genetic potential to full extent.

No single booklet can cover every subject as diverse and complex as dairying. Nor will probably everyone associated with dairying agree on all points covered in one publication. But we of Veepro Holland believe the combination of this manual and other publications on the subject may broaden your knowledge about artificial insemination and will subsequently contribute to a healthy and reproductive herd.

Veepro Holland wishes to continue providing you with the information and services you need to make profitable decisions for your dairy business.

We are indebted to those who contributed to this manual, particularly Dr. Maarten Pieterse of the Department of Herd Health Management and Reproduction of the Faculty of Veterinary Medicine, State University of Utrecht and Drs. Henk Jansen, Production Manager of the Giekerk A.I. Centre and reproduction consultant of Holland Genetics at Arnhem for their constructive criticism.

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VEEPRO HOLLAND
INTRODUCTION

The major advantage of artificial insemination (A.I.) over natural breeding is the control of spreading of venereal diseases, by avoiding the direct contact between males and females. This was the principal reason for the introduction of A.I. in most countries about 50 years ago. As from 1950 the application of A.I. developed rapidly and in ten years’ time the venereal diseases were eradicated in the Netherlands. At the moment, A.I. permits the dairy farmer to use top proven sires for genetic improvement of his herd. In contrast to natural service the farmer has, when using A.I., much more information available about the genetic transmitting ability of important traits of proven sires. A.I. is of tremendous value in making optimal use of different sires. This enables dairy farmers to breed individual cows to selected sires according to their breeding goal. However, the main constraint is to recognize early these outstanding sires on the basis of a good progeny test. Therefore, testing of young sires is essential to identify sires with superior transmitting ability for milk, fat and protein production, together with outstanding functional traits, such as udders, legs and feet. Through A.I. the usefulness of older, proven sires is extended beyond its limitations of age or physical handicaps that would have prevented their use in natural service. So for breed improvement it is essential to use A.I.-proven sires and no natural service.

Today, this is in fact by far the main reason for the widespread application of A.I. Do-It-Yourself A.I. (D.I.Y.) is one of the fastest growing trends in the dairy business worldwide and therefore this management manual aims at getting better results with A.I. and to acquaint yourself with the principles of D.I.Y.. Let us first discuss the reproductive tract of the cow, and thereafter, how the oestrus cycle functions, the importance of good heat detection and how proper A.I. is performed to get a better understanding of optimum fertility results.

THE REPRODUCTIVE TRACT OF THE COW

Vulva

The vulva is the external part of the cow’s reproductive tract and consists of two lips. At the bottom midline inside the lips of the vulva there is an organ of erectile tissue called the clitoris. Consult figure 1 (see page 4) for a schematic view of the cow’s reproductive tract. In front of the clitoris, five to eight centimeters from the lips of the vulva into the vagina, the opening of the urethra is located through which urine from the bladder empties. At the entrance of the urethra, urine flows into the bladder.
the urethra is the suburethral diverticulum, a small pocket of about 1 cm deep. The inseminator should be well aware of the location of these two openings, as it might happen, that the insemination pistolet is directed into one of them. To avoid this, the tip of the pistolet should always be directed upwards and forward for the first few centimeters, when entering the vagina.

In a few cases the vagina may be shut off by the mucous membrane; the vestige of hymen. Only in rare cases may this hymen partly shut off the vagina, but it may present some difficulty for the inseminator when it is not perforated.

Vagina and fornix
The vagina is the thin-walled portion of the reproductive tract extending from the opening of the vulva to the cervix. The first passageway up to the urethra is a few centimeters in length and is called the vestibule of the vagina. The vagina consists of tough and elastic connective muscular tissue. It is about 20 to 25 centimeters long and tends to become longer with age and the number of calvings. The vagina functions in natural matings as the place where the semen is deposited near the cervix. The fornix of the cervix is a blind pouch that encircles the projecting external part of the cervix in the cavity of the vagina. This pouch may cause some difficulties for an inexperienced inseminator when attempting to enter the pistolet into the cervix.

Cervix
The cervix forms the junction between vagina and uterus and is about 7 to 12 cm long and about 2 to 5 centimeters wide, depending usually on age and parity. When observing the cervix through the vagina you will see a projecting rosebud-like appearance with a heavy muscular passage in the middle. Three thick folds or rings keep the cervical canal tightly closed and only stretch completely at parturition. At oestrus this passage relaxes sufficiently to expel some mucus and for passing the pistolet. During pregnancy the closure of the cervix is complete to prevent infective material from outside to enter the gravid uterus.
**Uterus and uterine horns**
The uterus consists of two parts, the small uterine body and the two uterine horns. The uterine body is split up into a right and a left horn. The size of these horns depends on age, number of calvings and the length of time elapsed since the latest calving. In general, the horns have a length of about 20 cm in virgin heifers and up to 40 cm in older cows. The horns consist of erectile tissue and are curving forwards, downward, outward and upwards like the curled horns of rams. Of importance is that at oestrus, they become quite firm. At this time the horns are quite resistant to infections.

The target for semen deposition with A.I. is at the end of the cervix near the junction of the cervix and the uterine body. It is essential to keep in mind that the uterine body interior has a thin and sensitive lining. The pistol should be passed through the cervical opening up to the last part of the cervix as smoothly as possible for optimal results. Damaging the lining of the cervix opening may result in bleeding and strongly reduces the A.I. results.

**Oviducts, ovaries and follicles**
The oviducts have a length of about 20 cm. They are tubular and tortuous in structure, and are funnel-shaped at the ovarian end. The funnel-shaped portion is called the infundibulum of the oviduct and enfolds the ovary. At the time of ovulation an ovum (egg) is released into the infundibulum and subsequently transported through the oviduct to the uterus where it arrives about 4 days after ovulation. The released ovum passes into the oviduct where fertilization of the ovum may take place. After or without fertilization it is slowly propelled towards the uterus. The ovaries can be located by palpation at the end and besides the uterine horns. When palpated through the rectum wall, an ovary feels very solid, because of its large amount of connective tissue.

Irregularities on the surface of the ovaries are the result of follicles and yellow bodies, which develop during the oestrus cycle and at oestrus. The ovaries are the essential organs for reproduction and have a double function in the production of egg cells and hormones, such as oestrogens from the follicles and progesteron from the corpus luteum.

Follicles are always growing and regressing on the ovaries. They are fluid-filled with a blister-like structure, each containing an egg cell. One of these follicles matures at oestrus and ruptures (ovulation) in about 24 to 30 hours after the onset of oestrus. After its release it leaves an ovulation cavity in the ovary, which develops into the corpus luteum.

**THE HEAT (OESTRUS) CYCLE**
The heat cycle is controlled by Luteinizing Hormones (LH) and Follicle Stimulating Hormones (FSH). These hormones are excreted into the bloodstream by the anterior pituitary gland (AP) located at the base of the brain and regulated by the hypothalamus. The hypothalamus arranges the synthesis and release of the LH and FSH hormones. LH causes ovulation and growth of the corpus luteum and FSH stimulates the growth of follicles in the ovary.

The pre-ovulating follicle developing at the end of the oestrus cycle produces oestrogens, resulting in signs of oestrus. The rising levels of oestrogens in the meantime cause the release of LH, resulting in the...
Proper knowledge of the reproductive tract will certainly pay off

release of a mature egg (ovulation) into the infundibulum and oviduct. If cows are bred at the proper time, about 12 hours after the onset of oestrus, the egg can be fertilized in the upper part of the oviduct. The resulting embryo matures the next 3 to 4 days in the oviduct and is then propelled towards the uterus.

After ovulation the yellow body or corpus luteum (CL) is formed by cells lining the empty ovulation cavity of the ovary. The developing CL begins to excrete the hormone progesterone, which in case of a viable embryo, maintains pregnancy and prevents cows from coming in heat. If the cow is not pregnant, prostaglandin hormones produced by the uterus about 17 days after oestrus and ovulation break down the CL, resulting in a new oestrus after 3 to 4 days.

THE IMPORTANCE OF HEAT DETECTION

Successful A.I. starts at the person responsible for heat detection. The herdsmen must recognize and correctly interpret oestrus signs of the cow. Insufficient and/or inaccurate heat detection may lead to erroneous inseminations, reduced conception rates and consequently to extended calving intervals. In general, herd conception improves when one person assumes responsibility versus the role of several persons involved.

Of importance is that heifers and cows be properly identified and correct administration be kept for optimal results. Eartags or other means of identification are recommended for quickly and accurately recognizing individual animals. Without delay, dates of oestrus should be written on a herd fertility chart or a cow calendar. The administration should be checked daily to identify animal(s) which might come in oestrus.

Every 21 days on average, with a range of 18 to 24 days, a healthy heifer or cow will show signs of oestrus. The duration of oestrus differs from cow to cow and averages 18 hours with a range of 6 to 24 hours. Good detection results will be obtained when cows are observed routinely three times a day for at least 15 minutes each time. Early morning and late evening are excellent times for observing heat signs. Under tropical conditions the length of oestrus is shorter and therefore cows must be observed at least 3 times daily.

Furthermore, it is recommended that animals exercise freely to improve heat detection
Cows that are allowed free movement usually show signs of oestrus more clearly.

detection. Animals that are allowed free movement usually show signs of oestrus much better than tied-up animals, which makes heat detection easier. There are many signs of oestrus, including restlessness, bellowing, mounting other cows, licking, ear play, fighting, ruffled tail head, clear and mucous vaginal discharge and possibly a reduced feed intake and/or milk yield. Of all signs, the standing heat reflex (standing when being mounted) is the clearest sign of being in oestrus. Please consult Veepro’s Reproduction Management manual for more information.

Most cows show signs of oestrus relatively equally distributed over the day in moderate climates, whereas in the tropics most oestrus activity usually takes place during the cooler times of the day. Ovulation normally occurs about 30 hours after the onset of oestrus, which means that ovulation occurs after oestrus has ended. The presence of blood in the vaginal mucus is a physiological sign that the cow was in oestrus about 2 to 3 days earlier.

Recording of dates of heat and breeding

A ‘Herd Fertility and Health Monitor’ chart or cow calendar are convenient ways to record dates of heat, inseminations and calvings of individual cows. Besides this, computer management programmes are very useful in analyzing reproduction performance. Starting with the first-observed oestrus, each following date of oestrus should be recorded. All information, such as calving date, observed heats and service dates, should be recorded and used to calculate the herd reproduction efficiency.

In order to maintain an average calving interval of about one year, the average cow should be pregnant about 90 days after calving. Therefore, cows should generally be inseminated for the first time between 50 and 75 days after calving. It is advisable to pay extra attention to cows with retained afterbirths or endometritis cases. Cows not showing oestrus within 60 days after calving should also be examined carefully by a veterinarian.

All breeding dates, together with sire codes and animal data have to be dispatched to the herdbook association as soon as possible by the farmer practising D.I.Y. or by the A.I. associations. Birth dates and breeding data are checked according to herdbook rules and regulations for registration. The pedigree of the calf may be examined through blood-typing or DNA analyses for allowing herdbook registration, if these data do not agree with the herdbook requirements.
Inseminating at the right time

Insemination of cows just after the end of the standing heat period ensures the best results, as is illustrated in figure 2. Insemination of a cow still in early oestrus reduces the A.I. results. When A.I. is applied, all cows seen in oestrus in the morning, should be inseminated later the same day. Cows that are still in oestrus the next morning, should be re-inseminated. When oestrus is first seen in the afternoon or evening, insemination can safely be postponed until the next morning (AM-PM rule). With D.I.Y., cows should be served about 12 hours after the first signs of heat.

Quality of inseminations

The person performing A.I. has a great influence on the pregnancy rate. The best results will be obtained by an experienced A.I. technician. Proper training in A.I. techniques is essential to obtain optimal results. In hot climates, where cows have a shorter heat period, A.I. service should be available throughout the day. Under these circumstances, D.I.Y. might yield better results. Monitoring of the individual results of A.I. technicians helps to evaluate and improve pregnancy results.

Semen storage

Deep-frozen semen is stored at temperatures of minus 196° C in liquid nitrogen storage tanks or containers, without loss of fertility. At this temperature the semen keeps its quality and can be stored for many years. It is essential that semen containers be carefully maintained and movement be minimised to avoid nitrogen losses. The nitrogen level in the containers should be checked at regular intervals. All semen will be spoiled almost instantly as soon as the container no longer contains any liquid nitrogen. To increase the holding time, the container should be kept in a cool (air-conditioned) surrounding away from direct sunlight to avoid excessive nitrogen.

Semen can be stored in liquid nitrogen storage containers for many years without loss of fertility.
evaporation. A sire semen inventory record should be kept close to the storage tank for regular updating. Liquid nitrogen gas is odourless, tasteless and colourless. It is a nonflammable, nonexplosive and nontoxic gas, but can be dangerous if improperly handled. Liquid nitrogen containers should be stored in a well-ventilated room. It can cause frostbite on skin and eyes in seconds, so always remember to handle liquid nitrogen as carefully as you would do with boiling water.

results, the straw must remain in the temperature-controlled jar for about 1 minute. Fluctuations in temperature of the thawed straw must be avoided as much as possible. The plastic straw must be dried after thawing, because water is toxic for semen.

Use semen within 5 minutes after thawing
Equally important as storage, transfer and thawing technique is the use of the semen within 5 minutes after thawing. Sperm cells are very sensitive to temperature shock, which is important to keep in mind, because fertilization is partly determined by the number of viable sperm cells deposited. Besides this, the cow should be inseminated as quickly as possible after the thawing procedure to ensure a maximum number of sperm cells reaching the genital tract.

Surrounding ambient temperature
In order to obtain the same temperature as that of the thawed straw the cold insemination pistol is rubbed up in advance, before the semen straw is placed into the pistol. During hot weather the pistol should be protected from direct sunlight. All temperatures should be kept as close as possible to the body temperature of 38° C. Direct exposure to sunlight or a very warm or cold location will damage the semen.

Rectal palpation
Before entering the rectum, shape the fingers of your hand into a cone. Then pass your hand gently and firmly through the cow’s anus. Usually, this entering evokes a defaecation reflex. In any case, the dung within the rectum must be cleared out before proceeding the palpation. Palpation against the peristaltic waves within the rectum or against a rectum ballooned with air should be avoided anyway. When the rectum is filled with air, reach forward and gently grasp the first contracted ring of rectum mucosa and then pull slowly backwards. Usually, this will stimulate a peristaltic wave, resulting in evacuation of air from the rectum. Utmost care should be taken to avoid
contamination of the pistolet prior to insertion. By having one hand inserted within the rectum, the area around the vulva should be thoroughly cleaned with a disposable paper towel. The pistolet must be inserted without contact with the external body surface. Optimal hygiene during insemination is essential. The pistolet should not be stained with any dirt and for this reason, hold the lips of the vulva apart. This can be achieved by one of the following methods:

- the arm within the rectum should be lifted up sideways, resulting in parting of the lips of the vulva;
- place the fingers of your hand just inside the rectum with the thumb downward; through moving of the thumb sideways and retracting of the hand with thumb pressure against the vulva, the lips will part;
- if the above methods fail, a piece of disposable paper should be placed between the lips of the vulva and be left within the central cleft.

Your orientation points in rectal palpation are the pelvic brim (pubis), the shaft of the ilium (hip-bone) and mainly the cervix. First of all locate the pelvic brim and then sweep your cupped hand along the brim. The cervix can then be located as a firm, cylindrical structure in the midline at or just over the pelvic brim. For successful passing of the pistolet, the cervix must be immobilized and controlled by guiding the tip of the pistolet with the hand within the rectum.

The pistolet may bypass the external opening of the cervix and can be trapped in the fornix, when the cervix is not pushed forward far enough. Thereafter, it may happen that during insemination the pistolet is hindered behind one of the cervical folds. In rare cases the cervix can even be blocked. This will occur only in virgin heifers with an underdeveloped cervix. Generally, the lining and walls of the cervix are thick and tough enough to allow some movement of the cervix when passing the pistolet through the cervix. However, during insemination the pistolet should never be forced with excessive pressure through the cervical opening. Henceforth, the pipette should be passed upwards at a 60° angle into the opened vulva for about 5 to 7 cm and then tilted slowly horizontally till it reaches the cervix. Afterwards, hold the cervix at its vaginal

Optimal hygiene during insemination is essential for obtaining optimal results.
part and push it gently forward. This pushing forward prevents the external opening and the fornix of the cervix from interfering with the pistolet passage through the cervix. At this stage immobilize the cervix against the floor or the side of the pelvis. By holding the cervix in position with the thumb and forefinger, the pistolet can now be guided into the external opening.

The entry of the pistolet into the cervix can be checked by encompassing the cervix with the hand. If the pistolet cannot be felt in the fornix, you can be sure that the pistolet has penetrated the cervix. The passage of the pistolet is completed by moving the cervix horizontally and vertically while gently exerting pressure on the pistolet. You can be certain that the pistolet has passed through the internal rings when its tip can be felt at the end of the cervix. The pistolet should never pass more than 2 cm beyond the internal rings! At this stage the semen can be deposited (see figure 3).

Important points to remember:

• The pistolet should never be pulled out of the vagina and be re-inserted. This will cause contamination further up the vagina;
• The pistolet must not be withdrawn if the cow urinates or defaecates with the pistolet well inserted into the vagina. In such cases attempt to minimize faecal or urinal contamination by moving the pistolet to one side allowing the faeces or urine to drop to the ground without contaminating the pistolet;
• Do not attempt to guide the pistolet by violent manipulation of the end which is outside the vagina;
• At any rate the pistolet should never be forced through the cervix as this may result in a cervical abscess or perforation of the cervix;
• The uterus is a bacteriologically sterile organ, so do not allow the pistolet to cause any contamination;
• Inseminate in the last part of the cervix;
• In case of doubt concerning oestrus do not further inseminate at the end of the vagina, just before the cervix, so do not pass the cervix in this case.
SUMMARY

Good understanding of the reproductive tract and its function, with the emphasis on proper heat detection and correct timing of insemination are essential to achieve optimal pregnancy results. Everyone involved in herd management must aim at keeping reproduction efficiency as high as possible to ensure success.

The general guidelines for successful artificial insemination are:

1. proper understanding of the cow’s reproductive tract;
2. obtaining full and exact knowledge of heat signs;
3. carrying out heat detection on a scheduled basis;
4. accurate identification of animals;
5. correct timing of insemination;
6. keeping up-to-date breeding administration;
7. utilizing sound reproductive management practices;
8. using up-to-date insemination techniques for good results;
9. always maintaining high hygienic conditions during insemination;
10. calculating the herd fertility level at a regular basis for inseminator proficiency.
FURTHER REFERENCES

- Cow fertility management, Lecture notes IPC-Livestock/Dairy Training Centre ‘Friesland’.
- Fertility Management in Dairy Cattle by Esslemont, Bailie and Cooper.
- Physiology of Reproduction and Artificial Insemination in Cattle by Salisbury and VanDemark.

Earlier publications:

- Reproduction Management
- Young Stock Management
- Foot Care Management
- Feeding Management, Volume 1
- Feeding Management, Volume 2
- Milking Machine Management, Volume 1
- Milking Machine Management, Volume 2
- Proper Milking Management
- Udder Health Management
- Forage Management
- Fresh Cow Management
- Dairy Herd Administration Management
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All courses have a strong practice-oriented character based on the training concept of learning by doing. The practical training is very intensive; one instructor deals with groups of six students and for subjects like milking even with three students only.

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  - machine- and handmilking, milking machines, milk hygiene
  - feeding, ration calculation, feedplans, quality of feedstuffs
  - fertility management, heat detection
  - breeding, use of A.I., culling, body conformation
  - housing, tying/cubicle systems, hygiene
  - health, mastitis control, hoofcare
  - calfrearing
  - farm economics
  - farm administration

- **Forage production**
  - pasture management
  - fodder crops
  - silage making
  - farm machinery

- **Milk processing**
  - manufacture of cheese, butter, yoghurt, ice-cream, etc.
  - milk collection and payment systems
  - marketing
  - management of a dairy unit

- **Sheep husbandry**

- **Dairy goat husbandry**

- **Intensive beef production**

- **Horse keeping and animal traction**

- **Teaching methodology**

Visits to farmers’ organisations, A.I.-stations, Health and Extension service etc. are integrated in the courses to provide a good picture of the dairy sector in the Netherlands.

**AD HOC COURSES**

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This course is especially designed for persons in charge of a large-scale dairy enterprise, and includes all aspects involved in managing a dairy herd. The course offers a good opportunity to refresh one’s knowledge and learn about recent developments in dairy farm management.

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The centre has three farms, each with a different management system. One farm is especially equipped for international courses. The total stock at the three farms includes 240 dairy cows, 50 fattening-bulls, 45 dairy goats, 85 sheep and 12 Friesian horses. Additionally, the centre maintains close relations with twenty neighbouring farms which are used for practical training. Our staff consists of fifty dedicated and well-qualified trainers. All have up-to-date knowledge of modern dairy farm management, and over 70 man-years experience is present in various dairy development projects throughout the world.

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For more detailed information on our activities, please contact:

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