



## Artificial Insemination, Reproductive Cycles, and Heat Detection

Canadian Dexter Cattle Association Annual General Meeting  
August 14, 2010

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## What is AI?

- Artificial Insemination the injection of semen from a male into the vagina of a female by a chosen tool. . .

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## History of AI

- Artificial Insemination is older than everyone in this room's ages combined. Documents from around 1322 A.D. state that an Arab chief wanted to mate his mare to a stallion owned by his rival. So he preformed an amateur version of the artificial insemination we know today
- In 1780 Spallanzani successfully bred two dogs with the use of A.I. This lead him being named the inventor of artificial insemination.
- In 1899 Ivanoff in Russia worked on AI in birds, cattle, and horses and sheep
- The mass breeding of cattle however didn't come until later
  - in 1931 in Russia
- 1936 first A.I. Cooperation was formed in Denmark.

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### Advantages of AI

- The greatest advantage of Artificial Insemination is that it increases the maximum use of superior sires
  - ? Breed best to the best
- It allows easier access for consumers to obtaining high quality sperm
- You can compare herds easier
- Increase accuracy and selection intensity
- Introduce new genetics easier – increase diversity

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### Advantages of AI cont...

- The semen being used can be tested for disease
- You can identify genetic defects
- These all lead to genetic improvement in herds and cattle stock
- Don't have to keep a bull

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### Disadvantages of AI

- Requires a trained inseminator
- Requires more time and herd supervision
- Can reduce the genetic base

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### Disadvantages of AI

- Not being timed properly (in conjunction with the "heat" cycle)
- The semen not being handled properly

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### The plan...

- Estrous cycles
- Heat detection
- Artificial Insemination

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### Estrous cycles

- To understand cow breeding and accurately detect heat – a farmer needs to understand the estrous cycle of the cow
- ? period of time when orderly changes occur in the cow's reproductive organs, hormone levels and sexual behaviour

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### Important events of estrous cycle

- Period leading up to estrus
- Acceptance of the bull to allow mating (heat, estrus)
- Release of a mature, fertilizable egg (ovulation)
- Preparation of the uterus to provide a 'good home' for implantation and embryo growth

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### Estrous cycle

- Period of time from first signs of sexual receptivity (estrus) to start of next estrus
- 21 d long for a normal, healthy cow

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### Estrous cycle – hormone control

- Follicle stimulating hormone (**FSH**) secreted into bloodstream by the pituitary gland
- FSH causes follicle development in ovary in waves at 4, 10 and 17 days in the cycle
- A single follicle that develops late in the cycle continues to grow and produce **estrogen** – which causes signs of heat
- This follicle will mature and ovulate – releasing a mature egg, just after the period of standing heat (estrus)

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### Estrous cycle – hormone control

- Changing levels of estrogen cause release of **GnRH** (gonadotropin releasing hormone)
- GnRH causes the release of **LH** (luteinizing hormone) by the pituitary about 2 hours after the start of standing heat
- LH causes ovulation 24-36 h after start of standing heat
- Released egg will travel into the oviduct towards the uterus
  - ? If insemination occurs at the right time, fertilization occurs within the oviduct

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### Estrous cycle – hormone control

- After ovulation, follicle wall collapses and a corpus luteum (CL) is formed by the cells lining the cavity
- CL produces **progesterone**
- Progesterone prepares the uterine wall for implantation of the embryo and maintains the early part of pregnancy
- If cow is not pregnant, prostaglandins produced by the uterus breaks down the CL
- Progesterone production stops and cow comes back into heat

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### Estrous cycle – hormone control

- If the cow is pregnant – CL remains and continues to produce progesterone to maintain pregnancy
- Milk sample taken at day 23 after breeding can be analyzed for progesterone to detect pregnancy

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### Estrus (heat)

- Period of time when the female is sexually receptive and ovulation is about to occur
- Length
  - ? 16-18 hours

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### Signs of heat

- Standing to be mounted is considered the primary sign of heat. Most cows show increased sexual activity before estrus or actual standing heat.

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### Secondary heat signs:

- alert, restless behaviour, bawling, nervous, excitable
- shortened feeding time, reduced intake
- aggressive behaviour, butting
- swollen, reddened vulva
- mucus discharge
- withholding of milk
- increased urination
- mounting other cows
- chin pressing on other cows
- sniffing, licking of vulva, lip curling

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## Secondary heat signs

⇒ The expression of secondary heat signs shows a great deal of variation among cows. A few or all of these signs will be exhibited 6 to 24 hours before true standing heat. These signs should be noted and the cow watched more closely for standing heat in the next few days.

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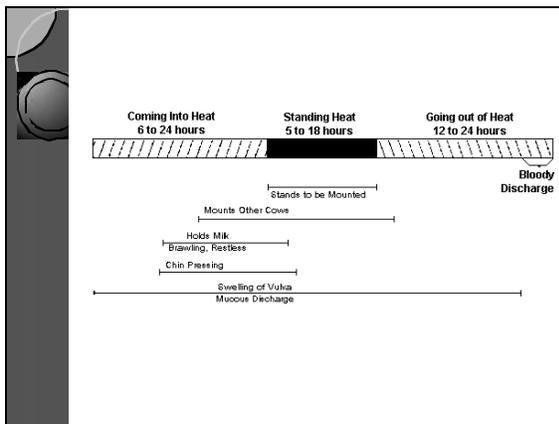
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## Standing heat

- ⇒ Only accurate indication when to breed is true standing heat
- ? Cow stands to be mounted by another cow
- ? Short time period
  - ⇒ 10 hours
  - ⇒ 25% less than 8 hours
  - ⇒ Usually at night – 70% between 6pm and 6am
  - ⇒ Shortest times occur when come into heat at night

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**Distribution of mountings by time**

Time	Mountings observed
6:00 pm to midnight	25%
Midnight to 6:00 am	43%
6:00 am to noon	22%
Noon to 6:00 pm	10%

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Cows show less signs of heat when other management practices such as milking and feeding are being conducted

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**Standing heat**

- Mounting activity increases with number of cows in heat
  - ? 11 mounts with one animal
  - ? 50 mounts with three animals
- May get some estrus synchronization
  - ? Result in some days of much activity, with other blocks of days without

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**Mounting Activity vs. # of Cows in Heat**

Number of cows in estrus	Total attempted mounts	Total number of stands	Stands per animal per hour
0	0.8	0.0	---
1	10.1	4.5	4.5
2	20.9	14.9	7.5
3	34.7	25.4	8.4
4	43.0	39.0	12.5
5	63.5	48.0	10.8

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- Visually detecting estrus**
- Cows must INTERACT
  - Cows must be OBSERVED
    - ? Average mounting time is 7 sec
    - ? Easy to miss

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- Heat detection**
- Carried out 2 to 3 times per day to detect cows in standing heat
    - ? Once per day – 60% detection
    - ? Twice per day – 80% detection
    - ? Three per day – 90% detection
  - Spend at least 20 min observing cows per observation

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### Heat detection

- Foot care is critical for mounting
  - ? Cows need to have feet in good shape
  - ? Exercise areas and walkways should have good footing
  - ? Grooving or scratching of smooth concrete surfaces is recommended.

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### Rules for good heat detection, breeding and insemination

- Tie stall barns
  - ? Turn cows loose at least once per day
  - ? Observe cows for at least 20 min
  - ? Observe cows 2 other times of the day
  - ? Do not feed or otherwise distract cows when checking for heats
  - ? Exercise area must have good footing

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### Rules for good heat detection, breeding and insemination

- Group housing or free stall barns
  - ? Ensure good footing in walkways/yards/pasture
  - ? Observe cows 3 times per day
  - ? Have unobstructed view of all cows from viewing area
  - ? Cows will NOT show good signs of heat when feeding or waiting for milking
  - ? Do not check while there is equipment operating nearby

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### When to breed

- First heat can occur at 14-22 days after calving
- Heat signs and conception rates improve until third heat at 50-70 DIM
- Plan to start breeding at 50 days after calving

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### Timing insemination

- The sperm and egg have limited lifetimes in the female reproductive tract
- Best time to breed is 12 to 24 hours after onset of true standing heat

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### Proper timing of insemination

Cows showing signs of heat	Should be Inseminated	Too late for good results
In morning	Same day	Next day
In afternoon	Morning of next day or early afternoon	After 3 p.m. next day

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### Timing insemination

- Watch for signs of heat after breeding
- Cow showing standing heat day after breeding should be bred again
- A bloody discharge will show after standing heat
  - ? 12-30 hours after breeding
  - ? Not all cows show this
  - ? Gives no indication of pregnancy
  - ? Good guide whether the timing of insemination was correct

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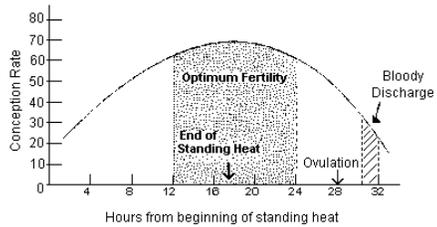
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### Heat detection aids

- Heat prediction
  - ? Important to accurate heat detection
  - ? 21d calendars, breeding wheels, computer systems help predict
  - ? System needs to be used daily
- Heat mount detection aids
  - ? Aid, but NOT a replacement for good reproductive management

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### Heat mount detection aids

- Heat mount detectors
  - pressure-sensitive devices that can be glued to the rump of the cow
  - In standing heat, when cows are fully mounted, the pressure causes colour change in the dye
  - Don't tell when a cow was mounted

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### Heat mount detections aids

- Cows can also be marked with special paint or grease pen – mounting will wear off or smear the marked area

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### Heat mount detection aids

- To be effective:
  - Position them properly to avoid false positives
  - Remove overhead objects on which cattle may rub
  - Minimum 1x heat detection is still required
  - Cattle must be loose, have good footing, and adequate space
  - Best used with heifers or problem breeders

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### Other heat detection aids:

- ⇨ Television cameras hooked up to a monitor in house or office
- ⇨ Pedometers
  - ? measuring activity (2 or 3 time increase during heat)
  - ? Must know what is normal
- ⇨ Changes in feeding behaviour (time, intake)

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### Other heat detection aids:

- ⇨ Heat-Watch
  - ? Computerized system involving patches (with a pressure switch) and a transmitter
  - ? Gives exact time animal was mounted, duration of mount, etc.
  - ? Patches can come off, not always reliable
  - ? Relatively expensive

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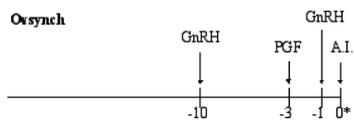
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### Controlled Breeding Programs

- ⇨ Synchronization of ovulation
- ⇨ Timed breeding programs
  - ? Ov-synch, pre-synch, CIDRs, PRIDs



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### Bull Selection

- AI allows for an enormous range of options in the bulls that you use
- Bulls are listed in catalogs and their pedigree and estimated progeny difference (EPD) are provided to help with the selection

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### Facilities

- Proper working facilities are a must when artificially inseminating cattle
- It eases stress and helps to prevent injury of all involved

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### The Collection of Semen

- There are several ways to collect semen. Although the use of an artificial vagina is most common
- The artificial vagina is made of a firm cylindrical tube that has a thin-walled rubber lining
- First the bull is allowed to mount a teaser cow
- Then as the bull ejaculates the penis is directed into the artificial vagina, where the semen is captured

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## Semen extension

⇒ The main reason for extending (or diluting) the semen is to increase the number of females that can be inseminated from one ejaculation. A normal ejaculate from a bull will contain 5 to 10 billion sperm, which can be used to inseminate 300 to 1000 cows if fully extended. There are several good semen extenders. Those made from egg yolk or pasteurized, homogenized milk are two of the most widely used. A good extender not only adds volume ejaculate but favors sperm survival and longevity. Dilution rate depends on quality of sperm per insemination have good conception rates. Penicillin and streptomycin are added to semen extenders. These antibiotics inhibit bacterial growth and reduce danger of spreading diseases such as vibriosis.

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## Handling Semen

- ⇒ A revolutionized discovery was made:
  - ? semen could be frozen
  - ? it can also be stored for indefinite periods
  - ? British scientists discovered in 1949 that addition of glycerol to the semen extender improved resistance of sperm to freezing
    - ⇒ glycerol removes water from the sperm before freezing.
    - ⇒ It also prevents the ice crystals from damaging the sperm

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## Semen Storage

- ⇒ Early methods included use of dry ice and alcohol (-100 degrees F, -73 degrees C)
  - ? When using dry ice and alcohol fertility declines gradually
- ⇒ Liquid nitrogen (-320 degrees F; -196 degrees C) is the preferred method
  - ? preferred because there isn't any deterioration with age

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## Artificial Insemination

### Steps

- ? Insert hand into the rectum and grasp cervix
- ? Insert insemination rod
- ? Deposit bull semen (slowly) into the uterus and remainder into the cervix as the catheter is withdrawn

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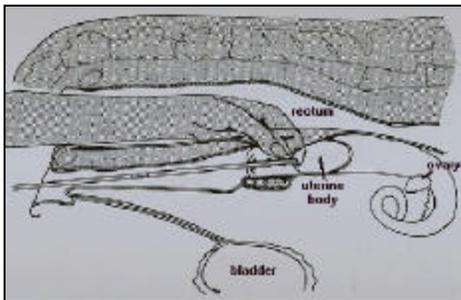
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## Artificial Insemination



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## Tools Used in AI

- Liquid Nitrogen tank
- Long gloves
- Insemination rod
- Paper towels
- Straw cutter
- Sheath
- Semen straw
- Warm water bath
- Thermometer
- Rubbing alcohol
- Clock
- Record books

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**AI Checklist and Steps**

1. Keep breeding kit clean and organized
2. Identify cow & check breeding record
3. Wash Hands
4. Have sleeve, sheath, gun, scissors, and towels ready before thawing semen.
5. Prepare water bath at 32-35 degrees C (90-95 degrees F) and place near tank
6. Keep semen below frost line while removing straws for thawing
7. Remove straws within 10 seconds
8. Shake straw to remove excess nitrogen and quickly plunge into water bath for 40-45 seconds.

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9. Insemination gun and sheath should also be warm (rub) and not extremely hot or cold to touch
10. Dry straw completely and check semen I.D. prior to loading gun
11. Clip 1/2" square from the end of the straw and apply sheath. Lock o-ring firmly in place.
12. Wrap prepared gun in dry paper towel or protective sheath and tuck close to body.
13. Clean vulva thoroughly prior to insertion of breeding gun.
14. Insert insemination gun at 30° angle to avoid urethral opening.
15. Pass rod through cervix, check location (uterine body) with tip of index finger and slowly deposit 1/2 of semen.

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**AI continued...**

16. Recheck location and deposit the rest of the semen.
17. Slowly remove gun and check for infection, blood, and semen feedback inside sheath.
18. Recheck semen I.D.
19. Properly dispose of sheath, towels and glove.
20. Clean gun if needed.
21. Record breeding information on barn chart and/or other record keeping system.
22. Recheck temperature of water bath prior to thawing additional straws and repeat the steps listed above.

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