Estrous Synchronization
Superovulation
and
Embryo Transfer
Estrous Synchronization

A management technique that makes use of hormones to control or reschedule the estrous cycle

Hormones associated with reproduction

- LH & FSH
- Progesterone
- Estrogen
- Prostaglandin
Why synchronize?

- Group females for parturition (calving interval)
- Shorten breeding season
- Reduce estrus detection
Advantages of implementing a synchronization program

- Calves produced early in season will wean heavier because they are older
- Cows require 40-60 days to recover from calving before next breeding
  - Cows that bred earlier have better chance of maintaining 365 d calving interval the next year
Basis for Synchronization of Estrus

- Manipulate life span of CL
- Manipulate growth of follicles and timing of ovulation
## Synchronization Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Tradename</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gonadotropins</td>
<td>Cystorelin</td>
<td>Mature females</td>
</tr>
<tr>
<td></td>
<td>Fertagyl</td>
<td></td>
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<tr>
<td>Prostaglandins</td>
<td>Estrumate</td>
<td>Cycling females</td>
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<tr>
<td></td>
<td>Lutalyse</td>
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<tr>
<td></td>
<td>Prostamate</td>
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<tr>
<td>Progestins</td>
<td>MGA</td>
<td>Pre-pubertal heifers</td>
</tr>
<tr>
<td></td>
<td>CIDR</td>
<td>Post-partum or Anestrous females</td>
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</tbody>
</table>
Synchronization Methods

Gonadotropins (GnRH protocols)

- Naturally occurring hormone that stimulates the release of LH and FSH that stimulates follicular development

- Protocols include Ovsynch and Cosynch
Synchronization methods

Prostaglandins

- Naturally occurring hormone that causes regression of the CL (luteolysis) and decreases progesterone secretion which results in a return to estrus
- Can expect estrus within two days following injection
- Protocols include PGF one-shot method and PGF two-shot method
Synchronization methods

Progestins

- Form of progesterone that extends the period of time progesterone is present and prevents animal from coming into heat

- Protocols include MGA+prostaglandin and CIDR
## Synchronization methods: drug trade names and effectiveness

<table>
<thead>
<tr>
<th>Method</th>
<th>Trade name</th>
<th>Female “type” for drug effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostaglandins</td>
<td>Lutalyse*</td>
<td>*Cycling cows or heifers</td>
</tr>
<tr>
<td></td>
<td>Estrumate*</td>
<td>∞Cycling mares</td>
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<tr>
<td></td>
<td>Prostamate*</td>
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<tr>
<td></td>
<td>Equimate∞</td>
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<tr>
<td>Progestins</td>
<td>MGA*</td>
<td>*Cycling cows or heifers</td>
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<tr>
<td></td>
<td>CIDR*</td>
<td>*Anestrous cows or heifers</td>
</tr>
<tr>
<td></td>
<td>Regumate∞</td>
<td>∞Mares</td>
</tr>
</tbody>
</table>

*Cattle

∞Equine

^Swine
**Synchronization methods: drug trade names and effectiveness**

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</thead>
<tbody>
<tr>
<td><strong>Gonadotropin Releasing Hormones</strong></td>
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<tr>
<td>Cystorelin*</td>
<td>Postpartum cows</td>
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<td>Fertagyl*</td>
<td>Anestrous cows</td>
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<tr>
<td>Ovuplant∞</td>
<td>Cycling mares</td>
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<tr>
<td><strong>Placental Gonadotropins</strong></td>
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<tr>
<td>PG600^</td>
<td>Peri-pubertal gilts</td>
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</table>

* Cattle  ∞ Equine  ^ Swine
Protocol for One Injection of Prostaglandin (PGF)

Cost $2.50/head

Beginning day of protocol schedule

Causes luteolysis of functional CL

PGF injection

Injected females should show signs of estrus within 1-4 days

Days 0 1 2 3 4 5 6 7 8 9 10

Inseminate females in estrus

10 day estrus detection

Females that have been inseminated prior to day 5 should not be administered PGF injection unless abortion is desired.
One Injection of PGF

**Advantages**

- Useful for detection of estrus in heifers and cows
- Decreased drug cost
- Limited animal handling

**Limitations**

- 10-25% of females may not be detected in estrus during days 0 to 10
- Poor degree of synchrony on females that return to estrus
- Must have CL
- Length of estrus detection
- Abortion
Protocol for Two Injections of Prostaglandin (PGF) with Split Insemination

1st PGF injection
(administered to all females scheduled to be synchronized)

Causes luteolysis of functional CL

Injected females should show signs of estrus within 1-5 days

Days 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Inseminate females in estrus

5 day estrus detection

2nd PGF injection
(only to those not inseminated)

Causes luteolysis of functional CL

Injected females should show signs of estrus within 1-5 days

Inseminate females in estrus

5 day estrus detection OR

Inseminate by appointment at 72 hr after PGF

Females that have been inseminated prior to day 11 should not be administered PGF injection unless abortion is desired.

Cost $4.70/head
Two Injections of PGF

- **Advantages**
  - Useful for detection of estrus in heifers and cows
  - Tighter synchrony than one injection method
  - Can use fixed insemination time after 2nd injection

- **Limitations**
  - Females must have functional CL
  - Length of estrus detection
  - Administration of PGF will cause abortion in pregnant animals
Protocol for Synchronizing Heifers using MGA and Prostaglandin

MGA is a synthetic progestin (similar to progesterone) which blocks the release of LH and prevents follicle maturation and ovulation.

MGA fed at a rate of 0.5 mg/head/day for 14 days.

Causes luteolysis of functional CL and a return to estrus.

PGF injection: 19 days after removal of MGA.

Discontinue MGA.

Estrus occurs between 2 and 5 days after removal of MGA, but females should NOT be inseminated due to low conception rates.

Inseminate females in estrus.

Cost $8.00/head
MGA and Prostaglandin

- Advantages
  - Proven system for heifers
  - Inexpensive method
  - Can hasten cyclicity in anestrous females

- Limitations
  - Length of program
  - Must have appropriate feeding space to allow efficient consumption
  - Estrus synchronization may be variable
  - Must ensure uniform daily consumption of feed supplement prior to and during oral administration of MGA
Cost $14.00/head
CIDR

**Advantages**
- Useful for detection of estrus in heifers and cows
- Induces cyclicity in a percentage of anestrous cattle
- High pregnancy rates

**Limitations**
- Possible retention failure of CIDR
- Cost per treatment may be higher than other methods
- An additional day of processing for hormone treatment would be required to facilitate fixed time AI
GnRH Synchronization Protocols

Basic GnRH synchronization protocols (Select Synch, Ovsynch, Cosynch) begin with the same format of an initial GnRH injection followed by a PGF injection 7 days later. Differences are derived from timing of insemination, estrus detection, parity, and hormone administration.

Select Synch

Ovsynch

Cost $9.00/head

Cosynch

Cost $9.00/head
GnRH

**Advantages**
- Higher and tighter rate of estrus synchrony compared to PGF protocols
- Allows for estrus detection or timed AI

**Limitations**
- Higher cost due to hormone injections
- Increase of time and labor
- Not recommended for use in heifers
Synchronization in the Mare

Products used: Equimate, Estrumate, Lutalyse

- When administered in diestrus, expect ovulation in 7-12 days
- If 30-35mm follicle is present, expect ovulation in 2-4 days
- Will only work when fully functional CL is present
- “short cycling” refers to restarting the estrous cycle early
- Prostaglandin should be given after day 6
- hCG can be given to mares resulting in immediate ovulation
Synchronization in the Sow

Prostaglandin will not cause CL regression until day 12 of cycle because LH binds to luteal cell receptor with strong affinity following ovulation and is not released until day 12. Repeated injections over two to three days will regress CL sooner, but is not practical.

- Common progestins will synchronize estrus but cause ovarian cysts
- Regumate has been found to be effective
- Noncycling gilts can be synchronized with P.G. 600 (400 IU eCG and 200 IU hCG)
Synchronization in the Ewe

Most common protocols use either use prostaglandins or CIDR
Embryo Transfer

- Removal of embryos from biological dam (donor) and placement into a surrogate dam (recipient) for differentiation, growth and birth
Purpose of Embryo Transfer

- Increase productivity of genetically superior donors
- Maximize use of valuable semen
- Transport genetics across long distances
- Production of identical offspring by embryo splitting
  - (potentially valuable as research animals)
Limitations of Embryo Transfer

- Expensive
- Labor intensive
- Requires extensive training and experience
Successful Embryo Transfer Requires:

- Superovulation
- Artificial insemination of the donor female
- Recovery of embryos from the donor
- Maintenance of embryos
- Transfer of embryos to recipient female
Superovulation

- Treatment of a female with gonadotropins (generally FSH) to increase the number of oocytes that are selected to become dominant follicles and ovulate
  - a typical treatment response in cattle would be 8 to 10 ovulations
Superovulation Procedures

- **Hormones used for Superovulation**
  - **FSH (follicle stimulating hormone)**
    - [Short half-life ~2 hours]
    - Used for commercial SOET
  - **PMSG (pregnant mare serum gonadotropin; eCG)**
    - [Long half-life ~ 2 - 4 days]
    - Not approved for use in commercial SOET in the US. Used frequently for research in Europe.
## FSH dosage for superovulation of cattle

<table>
<thead>
<tr>
<th></th>
<th>Bos Taurus</th>
<th>Bos Indicus</th>
<th>Heifers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>PM</td>
<td>AM</td>
</tr>
<tr>
<td>Day 1</td>
<td>5 mg</td>
<td>5 mg</td>
<td>4 mg</td>
</tr>
<tr>
<td>Day 2</td>
<td>4 mg</td>
<td>4 mg</td>
<td>3 mg</td>
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<tr>
<td>Day 3</td>
<td>3 mg</td>
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</tr>
<tr>
<td>Day 4</td>
<td>2 mg</td>
<td>2 mg</td>
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</tr>
<tr>
<td>Total</td>
<td>28 mg</td>
<td></td>
<td>22 mg</td>
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</tbody>
</table>
Steps of Embryo Transfer in Cows

1. Synchronization of recipients with donor

**Goal**: want donor and recipient to be in same stage of estrous cycle

**Reason**: preparation of recipient uterus to support embryogenesis

**How**: treat recipient with synchronization protocol that induces estrus to occur at same time as the donor
Steps of Embryo Transfer in Cows

2. Superovulation of donor female

**Goal:** hyperstimulate ovaries with gonadotropins

**Reason:** provide higher than normal numbers of follicles that will ovulate

**How:** inject donor with FSH
3. Inseminate donor with semen from genetically superior bull

**Goal:** to generate the best fertilization rates and genetic combinations possible

**Reason:** enhance rate of genetic progress

**How:** utilize highly fertile semen and trained inseminators
4. Recovery and identification of viable embryos

**Goal:** nonsurgically collect (flush) embryos from donor for transfer

**Reason:** to recover viable embryos

**How:** block with local anesthetic to relax rectum, at day 6-8 a Foley's catheter is inserted into uterus and inflated to prevent retrograde flow of flushing medium, introduce medium, lavage uterus and collect fluid
Steps of Embryo Transfer in Cows

5. Transfer of viable embryos into synchronized recipients

**Goal:** to deposit a potentially viable embryo into the uterine horn of each recipient

**Reason:** to achieve pregnancy in each recipient

**How:** a single embryo is placed into the uterine horn (ipsilateral to the CL) using a transfer pipette
Embryo Grading

Criteria for classifying embryos:
- Even number of cells
- Uniform division
- Healthy zona pellucida

Embryo Quality:
1 – Excellent
2 – Good
3 – Fair
4 – Poor
5 – Degenerate
Diagram showing a pipeline with labeled sections:

- Embryo
- Cotton Plug
- Sterile Media
- Air to insulate embryo