Increase your goat conception rate by improving your AI technique

Dr. Erick Loetz
Langston University

Introduction

Artificial insemination (AI) represents the first widespread use of assisted reproductive technologies adopted in goat production; now approximately a 3 decade old technique.¹ ² Among many benefits, when you can use thawed-frozen semen from bucks determined to be superior for specific economically important traits, AI has been proven to be invaluable for spreading and incorporating that specific selected genetic potential into goat herds.

AI can be performed in two basic ways that aim to place the male gametes (sperm) inside the uterus. Transcervical insemination (TrAI) and laparoscopically-aided insemination intra uterine (LAI) techniques have been used in combination with hormonal estrus/ovulation synchronization and more recently with fixed-time AI. This document focuses on transcervical AI since it is the technique used more frequently by goat producers.

Cost/benefit analysis

In most cases whether or not artificial insemination (AI) will be used depends on an economic issue (which should include time investment). The basic question has been and remains, under the existing conditions in our specific farm, does it pay to use AI? How much does the use of AI impact net return? Representative commercial goat data is very scarce to answer this question unequivocally.
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breeding, fecundity, prolificacy, and kidding rate.

Breeding program evaluation

There are several traits that can be taken into consideration when evaluating reproductive performance. Nevertheless, inseminating technique is best evaluated as early as possible in connection to an event which can be monitored to evaluate our success or failure. The first two landmark reproductive events that are a consequence of insemination are fertilization and conception. Both traits are, in practical terms, and with the technology available, undetectable.

Fertilization. The union of sperm and oocyte in the female’s reproductive tract lead eventually to the event we call “fertilization”; the creation of a one cell organism (i.e., the product of fertilization, the zygote) that has now two complete sets of genetic material coming in equal amount from the dam and sire. As the zygote divides it becomes and embryo which approximately by day 40 of pregnancy we will start calling a fetus until birth.

Conception. Unfortunately conception is one of the most difficult events to determine because it occurs during a time when the embryo and developing placental membranes (i.e., the conceptus) does not cause detectable changes in the mother’s hormonal chemistry until there is the so called “maternal recognition of pregnancy”. That is when the, until now “free-roaming”, embryo attaches to the mother’s uterus and causes the female to start important physiological changes in preparation for the approximately 5 months of gestation.

After maternal recognition of pregnancy it is possible to detect a chemical pregnancy or to evidence other physiological changes in the mother which are first observed when the female does not return to her next scheduled estrus or by actually seeing the embryo (30 to 45 d after conception) by means ultrasound imaging technology.

The important message is that a pregnancy is considered to be established only after implantation is complete. This implies that our effort to evaluate “AI technical ability” at a later time, by using for example pregnancy rate, means that we are in fact measuring the effect of many more influential factors than those
directly responsible of our good or bad AI technique. Therefore, the rule of thumb is that, the later we diag-
nose that a goat is “not pregnant” (open), the greater that the reproductive status result reflects, not only the
AI technique used, but many more influential factors.

**Biological traits behave in a curious way**

Biological quantitative traits do not have a fixed value. Hence, reproductive characteristics vary when
measured among different individuals. The variation in expression can be due to combinations of genetic
and environmental factors, as well as chance. This is why when we measure and re-measure, even when
using the same system, tools, etc. and even using the same animal and protocol of measurement, they never
(rarely) produce the same result. Therefore, when evaluating a trait we must consider this innate variability
before we conclude that two (or more) results are different.

Biologic traits, such as reproductive characteristics, express their values in a continuum. When all possible
values are gathered and organized from numerically low to high, they commonly are bunched up (distributed)
in such a way that when a graph is made using all these values, it forms a shape that reminds us of the shape
of a bell. Hence the name of a “bell distribution” or “bell curve” has been coined.

In practical terms a bell distributed group of data means that we have few low and high values at the
extremes of the bell curve and most (the average) at the center of the bell distribution. This means that when
we make only one or few observations we do not know where in the graph our observation is located. Is it a
reflection of a low, high value or is it a typical (average) value?

The reason why biologic variables behave the way they behave is because they respond to all kinds of
influential factors. In general influential factors are grouped into two large categories: Genetic and environ-
mental. All the influences that are not heritable, that is, passed from generation to generation are said to be
environmental. Productive traits are highly influenced by many activities and procedures we perform while
raising animals in a farm.

**What influences the conception rate attained?**

The list of influential factors which determine whether or not a female will become pregnant, as a result
of AI, is long and wide. Although in this workshop we are placing all our attention only on AI technique,
there is need to recognize two important concepts:

1. No matter how good our AI technique is, if the other influential factors are poorly managed the
   breeding program will be a reflection of all of them together. AI technique alone cannot make a
   positive difference.
2. If your AI technique is poor that is enough of an influence to bring down your breeding program
   regardless of all the efforts you may have placed to manage well all other influential factors. AI
   technique alone can make a negative difference.

**What influences AI technique results?**

When inseminating a goat five factors have major individual effects on the implementation of AI tech-
nique. The interaction between these factors can also be considered a separate influence:

1. The animal to be inseminated.
2. The AI technique used to breed the goat.
3. The proficiency of the person helping to restrain the goat (usually a necessity).
4. The AI equipment chosen.
5. The facilities used when AI’ing.
6. The interaction among all five single factors above.
Each of the above influential factors have themselves several components and they depend on individual choices and others are set by the type of goat operation a producer runs.

1. Not all females are good AI candidates.
   a. BCS
   b. Age
   c. Health
   d. Anatomy
   e. Personality
   f. Use past history:
      - On multiparous does use breeding records which show which mothers became pregnant to AI.
      - Select nuliparous doelings from easy breeding mothers.

2. Artificial insemination technique
   Knowledge.
   Experience.
   a. Make use of AI training programs. These programs can be as short as a 1-day course to a full college semester.
   b. Need to develop manual skills either by training with excised reproductive tracts and with live females.
   c. Organized area of work.
   d. Inseminating supplies should be kept dry and clean at all times. Leave breeding sheaths in the original package until used.
   e. Good sanitary practices.
   f. Learn how to create a low stress environment.
   g. Getting the animal
   h. Bringing the animal.
   i. Familiarity with facilities, people and equipment.
   j. Securing the goat.
   k. Lifting.
   l. So that your hands “see” where they are going you must get a good knowledge of goat reproductive anatomy.
   m. Avoid cold shock temperatures.
   n. Use non-spermicidal lubricants.
   o. Wipe the vulva region clean with a dry paper towel from top to bottom. Do not go over the same place with the same paper towel.
   p. Inserting speculum at the appropriate angle.
   q. Inserting the lighting device and appropriate manipulation.
   r. Finding the os cervix.
      Types of cervices.
   s. Appropriate semen handling, thawing and AI gun loading.
   t. The inseminating rod should be placed between the folds of the paper towel and inserted into the vaginal vestibule avoiding contact with the lips of the vulva.
   u. Speed.
   v. Getting through the cervix.
w. Goat categories (e.g., age, parity, breeds) as they all have peculiar challenging idiosyncrasies. Tractable and non-tractable goats.
x. Finding the target: body of uterus.
y. Relationship between sizes of different reproductive parts.
z. AI technique fine-tuning accomplished by improving on an already good technique… again and again.

3. Proficiency of helping hands.
a. Should be familiar with the procedures used and be part of the necessary pre-established choreography not a hindrance to the flow of events.
b. Bringing the selected goat at the appropriate time.
c. Ensure goat is indeed in standing estrus.
d. Check goat identification.
e. Correct manner to have the animal climb on the milk stand.
f. Correct head restraint.
g. If using a milk stand with adjustable height makes sure the appropriate height is chosen.
h. Usually chooses and prepares the speculum.
   i. Correct size.
   ii. Correct lubrication (amounts and placement).

i. Restrain of the animal should be deliberate, gentle and accomplished in one smooth effort.
   i. Needs to know where to place his supporting leg.
   ii. Correct manual restraint to prevent injuries to the goat and to the AI technician.
   iii. Correct alignment of the animal.
   iv. Correct stretching of body.
   v. Attentive and responsive to verbal commands and/or other cues (body language) of the lead inseminator.
   vi. Correct way of bringing down the animal to full four legged stance.
   vii. Correct way to let the animal down from the stand.

4. AI equipment chosen.
a. A complete AI kit is necessary. See (Loetz, 2006)\textsuperscript{5}.
   1. Organized.
   2. Clean
   3. Some items must be kept sterile.
b. ii. Must be familiar with the use of each tool used.
c. iii. Must have replacement parts. Murphy’s law.
d. iv. Lighting always an issue. Ensure extra batteries.

5. Facilities used when AI’ing.
a. One that the goat is familiar with.
b. Clean.
c. Good lighting.
d. Isolated and calm.
e. Safe.
f. No drafts.
g. Cool temperature. Avoid extremes if possible.
6. Interaction among AI influential factors (1→5).

The interaction between all influential factors is difficult to predict beforehand. Experience helps but experience also shows that, if there is one thing you can count on, that is the unpredictability of events. Be ready to deal with various challenges. All your frustrations and behavior thereof, will affect your technique if you are unable to bring them under control. Animals will respond to your mood. When at all possible have a plan B.

**AI Technique goals:**

By accomplishing the following goals you will, not only become a successful AI technician able to generate high conception rates, but increase considerably the chances of having a positive cost/benefit ratio in your AI program as well as becoming a profitable goat producer.

- Animal welfare
- Hone your AI technique by fine-tuning each procedure.
- Consistency. Will allow you to troubleshoot problems.
- Accuracy. Will allow you to be close to the target.
- Precision. Ensures consistency in your attempts.
- Speed. Short AI’ing time means less stress on the animal.
- Volume. Increase the number of goats you are able to AI.
- Generate honest, retrievable, and readable record keeping.

**Summary**

Whether or not artificial insemination (AI) is a procedure that will provide you with a positive return to your investment is directly related to the size and type of your goat operation. The cost/benefit analysis is highly influenced by the conception rate you can attain in your particular facilities. The number of goats that get fertilized, conceived and go on to become pregnant per insemination is the outcome resulting from a multitude of factors that interact in an intricate fashion. The more relevant effects on reproductive performance are a result of: female and male fertility, reproductive health, changes in body condition (which are dependent on the appropriate nutrition) age, breed, parity, environmental factors, worm load, reproductive management, tech-niques used in AI, which include accuracy of heat detection, timing of insemination, semen han-dling and placement in the reproductive tract. This document focuses on only one factor (the transcervical technique used at time of insemination) and its effect on one reproductive trait (conception rate) as measured indirectly by pregnancy rate.
How to detect heat in goats

“Heat occurs during estrous. Estrous is defined as the period of time when the female is receptive to the male and will stand for mating. Accurate heat detection is the key to a successful artificial insemination program. If you can’t catch the doe in heat, it doesn’t matter how good the semen is, how careful your thawing procedure, or how skillful your insemination technique. In the figure below, heat occurs approximately 17-21 days after estrous when there is a spike in FSH,LH and estrogens and a reduction in p4”.

Source: http://www.infonet-biovision.org/default/ct/791/livestockspecies

Hormonal changes in the peripheral plasma during the goat estrous cycle.

Fertility process 6-28 hours after the onset of heat *

<table>
<thead>
<tr>
<th>Heat Period</th>
<th>Before heat</th>
<th>Standing heat **</th>
<th>After standing heat</th>
<th>After heat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours after onset of heat</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>When to breed for best success</td>
<td>Too early to breed</td>
<td>Good time</td>
<td>Excellent Time To Breed</td>
<td>Good time</td>
</tr>
</tbody>
</table>

* Heat: the female reproductive cycle  
**Standing heat: that point in a doe's heat cycle when she is receptive to the buck

Source: http://www.infonet-biovision.org/default/ct/791/livestockspecies
Literature Cited


6. Hutchens T. Overview of Artificial Insemination of Kentucky Meat and Dairy Goats