REPRODUCTIVE BIOTECHNOLOGY (AR-402)

Biotechnology
"It is the use of chemical, physical and genetic engineering techniques and principles through the biological system to produce goods for human beings."

Artificial Insemination
It is the collection, evaluation, preservation, processing of semen and transferring to the female reproductive tract by artificial mean for the purpose of pregnancy.

It is most widely accepted technique worldwide for the genetic improvement in animals. For large no. of animals

History

- In 1300's, Fredrick Exuctiat first inseminated his mare with the stolen semen from an outstanding stallion. But no result was found.
- First fully documented A.I. was reported in 1780, when an Italian physiologist, L. Spallanzani" carried out it in his own bitch, and he got three puppies after 62 days.
- Before this in 1677, Leeunehook first time observed the spermatozoa under microscope and he concluded that semen must contain motile things.
- In late 19^{th} century studies were made on the physiology of male reproductive system.
- In 1897 – Walter Haep, first time discovered that one ejaculate can be divided and served for multiple female animals. He worked on dogs and horses.
- In 1899-1900 – Iwanoff worked on A.I. in birds, camel, horses, sheep successfully.
- In 1914 – G. Amntae developed artificial vagina for semen collection – for dogs and later on for other animals (bulls, stallions).
- In 1931 – Russia took A.I. at mass scale and several thousand cows were bred via A.I.
- First association of A.I. (A.I. Association) was established in Denmark in 1936.
- In 1937 – J.E.Peri (USA) developed rectovaginal technique for A.I. for large animals.
- In 1930's – extenders / semen dilutors were developed.
- In early 1940's – electro-ejaculators were developed.
- In 1940's – role of glycerol was described as cryoprotectant for semen.
- In 1964 – first time semen was frozen in straws before this semen was kept in ampule.

A.I. Cooperative Societies

- AI cooperative societies come into existence in 1937-1940 in the following three states of America (USA):
    (a) Cornell
    (b) Minnesota
    (c) Wisconsin's
- In 1940 – it was decided that antibiotics should be added in the semen.

A.I. in Pakistan

- First AI centre was established in 1954 at College of Veterinary Science.
- Later on, a 5-years project was started named "Field trials for A.I." during 1961-64 – under this project, about >8000 buffaloes and 5000 cows were inseminated.
- Directorate of Livestock and Dairy Development recommended A.I. in 1962 for dairy animals of all the government farms as breeding tool.
- In 1971 – 3 organizations were established:

(i) Directorate of A.I.
(ii) Semen Production Unit (SPU) - Qadirabad
(iii) Animal Reproduction Deptt. UAF

Other Semen Production Units (SPU) working at present:
SPU – Kareimurat
SPU – Kiraniwala (BWLP)
SPU – Kalookot

A.I. in Punjab
Cows: 10-15 %
Buffaloes: 5-10 %

SPU- Qadirabad
It was established in 1971 – supplied the semen to the other center and sub-centers.
2 centers are working in : (a) Sheikhupura (b) Shahkot

Army has also developed their own SPU 2 years before at Renalakhurd, where exotic Holstein cows are crossed with Frisian bulls and pure semen is available. Mobile subcentres are also working in numerous cities including Faisalabad.

In the Department of Theriogenology, UAF
Semen in liquid form of:
(a) Nili-Ravi (b) pure Sahiwal, and (c) Holstein x Frisian, available.

Important Points for Semen Evaluation:
Semen evaluation is very much important as for as mass activity and sperm concentration is concerned.
An ejaculate must possess 50% sperm motility at least.
If a fresh ejaculate found with 70% sperm motility, then if it is stored at 4C in the refregitor, then after 3 days – its sperm motility ultimately reaches to almost 50% (as there is a fall in 10-15% sperm motility every day).

Companies Import the Semen
Altaf and Co.
Profarma LHR. :
Import semen, also deal in A.I. equipment and provides A.I. Service at farmer's door step.

Cost of A.I. Dose:
Holstein x Frisian semen : 700-5000 Rs. depending upon the genetic value of the sire.
Among Livestock, A.I. is most benefited in Cattle – more advantageous. In 1930's and 1940's more technology was refined for cattle.

Advantages of Artificial Insemination

(1) It is the mean of genetic improvement.
(2) No. of bulls covers breeding females is reduced but the intensity of selection is very much high.
e.g. 1% of best cows ---- are selected as bulls' mothers, based on their performance.
+++ Milk production is sex-limited trait but sire also influence it. Remember it please.
+++ Few progeny tested bulls for buffaloes are available at Qadirabad in Pakistan.

(3) Helps in control of infectious diseases.
A.I. bulls are vaccinated and semen is checked/tested.
Previously, outbreaks of venereal diseases were reported as:
Campylobacteriosis
Vibriosis
Trichomoniasis
Brucillosis
Leptospirosis
To avoid the contamination of *Staph*. *Strept*. and E.*coli*…certain antibiotics (such as streptomycin and penicillin) are added in the semen.

(4) Helps to reduce the reproductive infections

(5) Detection of certain female reproductive problems e.g. endometritis.

(6) Helps in the detection of male fertility
For this purpose: ***Livablilty Index*** is performed (A test for detection of semen fertility)

(7) Promotes International Trading – due to which now services are available at door step.

(8) Disability of mating – can be corrected by use of electric ejaculator and in this way semen of such superior bulls can come into use.

(9) Artificial Insemination has contributed in the advancement of reproductive technology.

(10) Breeding services of a dead bull remain viable many years after his death.

(11) Semen Sexing is only possible in A.I. – sexing helps in getting progeny of desired sex..

(12) A.I. contributes a lot in Embryo transfer technique and in vitro embryo fertilization etc.

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Table: **CHARACTERISTICS OF NORMAL EJACULATES IN DOMESTIC ANIMALS**

Semen Charact.	**Stallion**	**Bull**	**Ram**	**Boar**	**Dog**	**Nili-Ravi Bull**	**Sahiwal Bull**
Duration of Ejaculation	30-60 sec	1 sec	1 sec	5-25 min	1-45 min	-	-
Normal Site of Deposition of Semen	Vagina & Uterus	Vagina	Vagina	Uterus	Vagina	-	-
Volume of ejaculate	30-100 ml	5-10 ml	0.5-2 ml	30-300 ml	0.5-50 ml	4 ml (>15ml)	5 ml (15 ml)
Fractions	Three	One	One	Three	Three	-	-
Concentration of spermatozoa	100-800 x 10^6 per ml	500-3000 x 10^6 per ml	3000-6000 x 10^6 per ml	100-500 x 10^6 per ml	4-400 x 10^6 per ml	0.5-2.0 x 10^9 per ml	0.8-2.0 x 10^9 per ml
Progressive Motility (%)	>50	>70	>90	>80	>60	>70	>70
Recommended number of spermatozoa per semen dose:							
- Fresh	500 x 10^6	5 x 10^6	300 x 10^6	2000 x 10^6	150 x 10^6	-	-
- Cropreserved	250 x 10^6	15 x 10^6	400 x 10^6	5000 x 10^6	200 x 10^6	-	-

SOURCE: SPU – Bahadurnagar (Distt. Sahiwal)