NEW TECHNOLOGIES IN ANIMAL BREEDING

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Introduction

- As a business, breeding poses many challenges to breeders
- To be successful, breeders have to:
  - Stay up to date with new developments,
  - Be able to recognize developments and innovations that can aid their business,
  - Implement developments in effective and rapid manner
- Some important technologies impacting Animal Breeding:
  - Artificial Insemination
  - Best Linear Unbiased Prediction (BLUP) of breeding values,
  - Halothane Test,
  - Ultrasound Technology.
Role of Molecular Genetics

- Genetic progress for quantitative trait – phenotype or EBV from phenotype,
- Unknown knowledge of number of genes and individual gene effect,
- Genetic improvement – “black box”,
- Improvements to date is evidence of the effectiveness of these approaches.
- Knowledge of genes and gene action may further enhance improvement.
Effectiveness of Molecular Genetics vs. Phenotypic Information

- Molecular genetics information is not affected by environmental effects,
- Availability of molecular information at an early age allows for early selection and reduction in generation interval,
- Molecular genetic information can be obtained on all selection candidates.
Application of Molecular Genetics in Breeding Programmes

- Molecular Genetics
- QTL Detection
- Genetic Evaluations
- Marker Assisted Selection (MAS)
Factors determining genetic improvement:
- Intensity of Selection ($i$),
- Accuracy of Selection ($r$),
- Genetic Standard Deviation ($\sigma_g$),
- Generation interval ($L$),

$$\frac{\sum ri\sigma_g}{\sum L}$$
Factors Limiting the Design of Breeding Programmes

- Genetic parameters,
- Traits of interest that are sex limited and mature late in life
- Reproductive rate
- Inbreeding
- Limited resources available for testing animals
- Logistics of operating complex breeding programmes
Some Recent Developments in Reproductive Technologies

- MOET (Multiple Ovulation and Embryo Transfer)
- IVEP (In-vitro Embryo Production)
- Cloning
Conventional Progeny Testing Schemes

- AI – first reproductive technology with major impact on breeding programmes for dairy cattle
- Remove reproductive constraint on males,
- Theoretical rates of genetic gain of 2 to 3%/year.

Constraints:
- Low female reproductive rate
- Long generation interval
EMBRYO TRANSFER (MOET)

- Reduces the low female reproductive rate,
- Potential to increase genetic gain by 2 to 10%,
- Use in dam of cow pathways genetically more promising,

- Constraints:
  - High labour cost
  - Large number of transfers needed.
In Vitro Embryo Production (IVEP)

- Oocyte harvesting, maturation and in vitro fertilization,
- Facilitates larger response to selection within the dam pathway resulting from possibility for increased selection intensity,
- Potential for juvenile selection schemes given the possibility for oocyte aspiration at a very early age – reduction in generation interval (L) – increased genetic gain.
Cloning

- This allows for the replication of genotypes.
- The approach provides the scope for immeasurably increasing the selection intensity and thereby increasing the genetic gain.
IMPLICATIONS

- With increased reproductive rates, inbreeding becomes the limit to genetic progress,
- Use of breeding methods that increase genetic gain and limit inbreeding should be employed.
- Some of these methods are:
  - Limit the size of the breeding programme,
  - Utilize outside stock,
  - Establishment of several closed lines with intermittent crossing,
  - Restriction on the selection of relatives,
  - Restriction of emphasis of family information in selection criterion,
  - Avoidance of mating of relatives
  - Use of factorial mating design.
CONCLUSION

- Animal breeders continuously seek to improve livestock production efficiency,
- There are genetic and biological constraints to realizing this objective,
- There is continuing research to find ways to overcome these constraints,
- Some of the outcomes of research in the form of molecular and reproductive technologies have been outlined.