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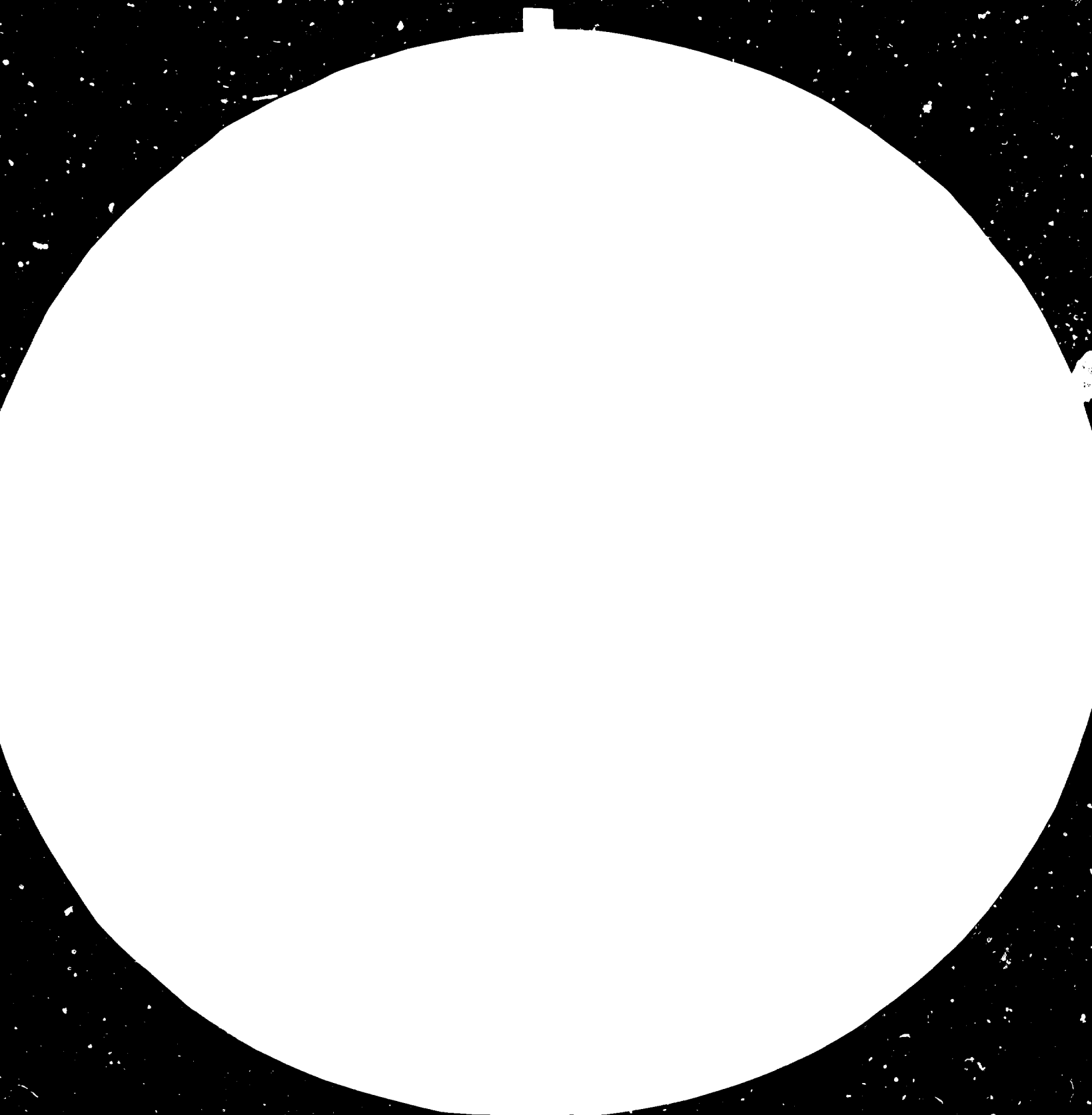
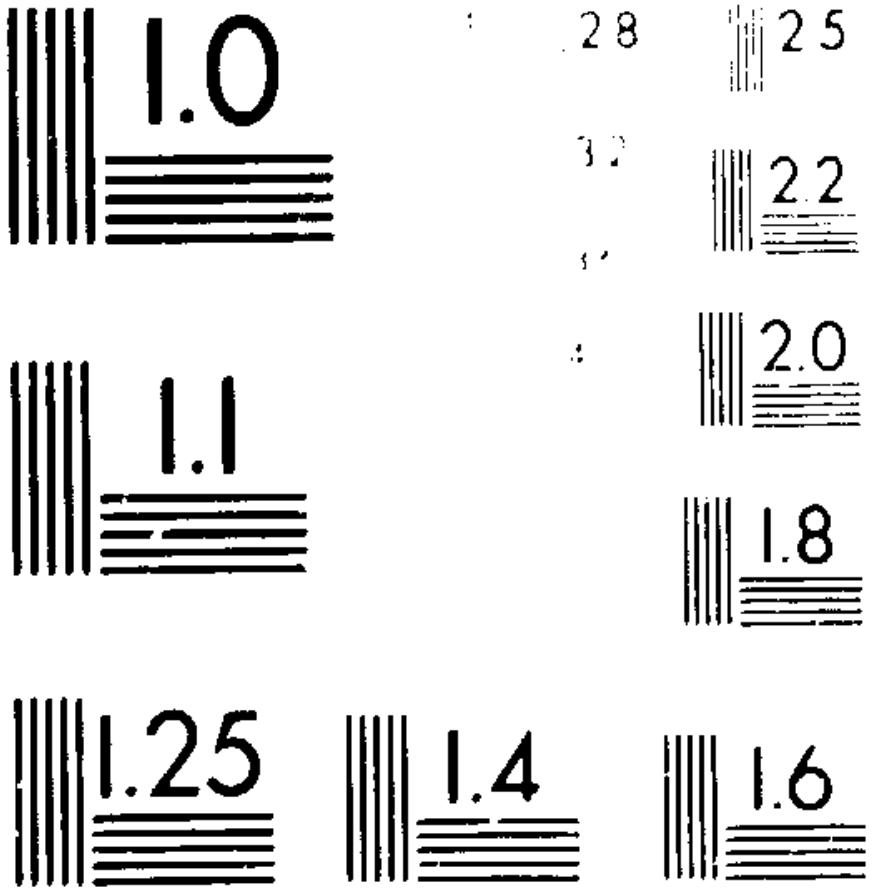
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org





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THE POTENTIAL APPLICATION OF EMBRYO TRANSFER TECHNOLOGY TO CATTLE BREEDING IN TRINIDAD AND TOBAGO*

by

Gustave Borde**
and
Vincent Moe**

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** Veterinary Services Division, Ministry of Agriculture, Lands and Food Production, Republic of Trinidad and Tobago.

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HISTORICAL DEVELOPMENT OF EMBRYO TRANSFER

1890 - Walter Heape performed the first embryo transfer (between rabbits) at Cambridge University.

1951 - U.S.A and U.S.S.R. reported first successful transfers in pigs and cattle.

1961 - Successful transportation of sheep embryos from Britain to South Africa, using a rabbit to incubate the embryos in her fallopian tubes - some success with non-surgical collection and transfer methods.

1969 - Surgical techniques in cattle that produced excellent pregnancy rates were developed at Cambridge.

1970 -, Commercial boom in the proliferation of exotic breeds led to further progress in development of transfer techniques.

1972 - exportation of bovine embryos of one breed, in recipients of another, was accomplished.

1973 - Successful freezing techniques for mouse eggs, calves and lamb
1974 were also obtained from frozen embryos.

1975 - First successful transfer of a non-human primate embryo.

1976 - Commercial exportation of bovine embryos in test tubes.
- development of non-surgical collection and transfer techniques in cattle began to yield results similar to those achieved surgically.
- sexing of embryos.

Embryo transfer technology has many useful research applications particularly in the areas of reproduction, genetics, production and disease research programmes. In addition to its contribution to research programmes it can be used for the improvement of the livestock sector in developing countries. The greatest technological advances have been made with cattle. Some of the reasons for this are:

(a) the small size and the difficulty of passing cervical catheters in sheep goats and pigs have led to reliance on surgical methods of embryo collection and transfer.

(b) the value of individual cattle is much greater than that of smaller livestock.

(c) the reproductive rate in smaller livestock species is normally higher than cattle and potential improvement would probably be less.

The steps involved in embryo transfer are outlined in Table 1 and 2. It is important to emphasize that the advances made in non-surgical collection and transfer can now produce results similar to those obtained with surgical methods, and has helped to significantly reduce the cost of embryo transfer. It is also anticipated that with further developments in the area of freezing of embryos and the sexing of embryos, greater economic benefits will also be derived.

Applications and limitations for embryo transfer technology to cattle breeding in Trinidad and Tobago.

Embryo transfer technology has several important areas of application for the livestock sub-sector of Trinidad and Tobago.

1. Embryo transfer technology provides for a feasible means of moving livestock internationally as embryos. Improving techniques for maintaining embryos in culture and for preserving them by freezing will lead to an extension of this application, when the necessary expertise exists at the place

of origin and at the destination. This could lead to a significant reduction in the cost of importing animals for use in livestock development programmes in developing countries. The cross-breeding project at the Aripo Livestock Station has utilized imported Holstein animals, primiarily from the U.S.A. and Canada, to form the nucleus of the parental stock. A distinct advantage provided by importing embryos would be the reduction in losses associated with the acclimatization process and disease problems eg. Anaplasmosis/Babesiasis. Embryos implanted in recipient animals would benefit by acquiring immunity in early life and would undergo a gradual climatic adaptation which could possibly reduce the negative effects of acclimatization on production parameters.

2. Genetic improvement of indigenous breeds by increasing selection intensity among desirable genotypes. It has been shown that the production of six off-spring per donor could double selection intensity and the rate of response to genetic selection for traits eg. growth rate, that can be measured in both sexes. Although intensity of selection for sex limited traits eg. milk yield could also be improved by embryo transfer , it is generally accepted that the gains would be marginal and less than could be achieved by optimizing selection schemes using conventional reproduction.

3. Importation of 'exotic' breeds eg. Jamaica Hope, Australian Milking Zebu, Jamaica Red which have been developed to maximize production under tropical and sub-tropical condition. The high demand for some of these animals have limited their availability in sufficient numbers to make a favourable impact on the livestock sector.

4. The Artificial Insemination Service could derive some benefit from the use of embryo transfer technology by

(a) provision of a wider genetic base for selection of superior bulls for use on farmers cows.

(b) provision of a wider variety of breeds for use in the Artificial Insemination Service eg. Brown Swiss Jerseys.

5. Trinidad is one of a few countries in the Western Hemisphere, free from foot and Mouth Disease and Brucellosis with an indigenous supply of water buffalo. Recently, some of these animals have been exported to Latin America and the U.S.A. The potential for the development of an export market for Water Buffalo embryos is another area of possible application for this technology.
The importation of water buffalo embryos to up-grade selective traits eg. milk production on local buffaloes could be an additional area of involvement.

The adoption of a new technology and the transfer of technology to developing countries must be based on a thorough scientific evaluation of the possible benefits to be derived by the application of such technology. The present limitations to the successful economic development of the livestock sector viz. poor nutrition, management and reproductive performance will not be conducive to the successful application of embryo transfer technology on a large commercial scale. The Veterinary Services in its 1984 Development Programme has submitted a project on embryo transfer technology. The general and specific objectives of the project are summarized.

(a) General

(i) To provide suitably qualified personnel with the knowledge and skills in embryo transfer technology.

(ii) To establish the potential benefits to be derived by using embryo transfer technology in Trinidad and Tobago.

(iii) To determine the economic feasibility of using embryo transfer technology in Trinidad and Tobago.

(iv) To investigate the potential application of this technology in dairy and beef cattle in the first instance and with a view to exploiting its commercial application in the reproduction of water buffalo for the export market.

(b) Specific

(i) To establish whether embryo transfer under local conditions can achieve similar rates of success as is obtained in the more advanced countries.

(ii) To compare the relative cost of achieving this level of performance with the cost of cattle importation and the natural conditions of cattle reproduction based on an assumption of one calf every 14 months.

(iii) To determine whether the technique of freezing water buffalo embryos can be applied and whether there is a viable overseas commercial market for these embryos.

(iv) To establish the potential input and application of this technology to the present cross-breeding project at the Aripo Livestock Station i.e. selection of superior cross-bred

cows for donor animals and eventual rapid multiplication within the framework of the cross-breeding project.

(b) Specific

(v) To investigate its contribution to the Artificial Insemination Service in the form of superior bulls for use on farmers cows.

(vi) To determine if farmers could be provided with animals that have an improved genetic potential for increased milk production, heat and tick resistance, taking into consideration, management constraints. This will involve projects to fully exploit environmental adaptation and disease resistance of local cattle, using them as recipients for embryos of different genetic and environmental background or of highly productive animals of a similar environmental background.

TABLE I Steps involved in embryo transfer.

Stage I - Selection of donors and recipients
Superovulation of donors.
Synchronisation of donor and recipients.
Insemination of donors

Stage II - (a) Embryo recovery -
(i) collection of embryos
(ii) examination and selection of embryos
(b) Embryo storage -
(i) short term - less than 24 hrs.
(ii) long term - deep freezing liquid nitrogen.

STAGE III - Embryo transfer
(i) surgical transfer
(ii) non-surgical transfer.

TABLE 2: SUMMARY of the Advantages and limitations to methodology of embryo transfer technology.

EMBRYO TRANSFER TECHNOLOGY	METHODOLOGY	APPLICATION (T&T)	LIMITATIONS	EXPERTISE (T&T)	Advantages
SELECTION OF DONORS & RECIPIENTS	-	1) DHIS 2) Cross-Breeding Project 3) Artificial Insemination Service 4) Water Buffalo	1) adequate progeny testing programs 2) 15-20 recipients per donor 3) cost of maintaining a recipient herd	available	rapid & improved genetic gains in the livestock sector.
Super-ovulation of donors	PMSG-2000±500I.U luteal phase of cycle -PG-48hrs. later mean 17+ 3 range 0 - 53	-	significant variation in response to standard super. ovulation treatment	available	-
Insemination of donors	-	A.I.S.- use of A.I. Technicians	requires good fertility and use of high quality semen.	available	-
Synchronisation of donors & recipients	use of natural or synthetic prostaglandins	-	none 95% effective	available	highest pregnancy rate ± 1 day

DHIS - Dairy Herd Improvement Scheme

PMSG - Pregnant Mare Serum Gonadotropin

EMBRYO TRANSFER TECHNOLOGY	METHODOLOGY	APPLICATION (T&T)	LIMITATIONS	EXPERTISE (T&T)	Advantages
EMBRYO RECOVERY	Non-Surgical (Dys 6,7,8) Collection Examination & Selection of embryos	-	Recovery Rate 50-60% Operator Skill and experience difficult to maintain sterility	not available	
EMBRYO STORAGE	a) Short term buffered salt soluations with serum 24 - 35°C (< 24hrs.)	-	a) requires maintenance of a recipient herd ↑ cost	not available	a) higher success rates
	b) Long term Liquid Nitrogen & Cryoprotectants DMSO or glycerol	-	b) requires post-thawing selection availability of suitable embryos ↓ conc rates.	not available	b) reduces the need to maintain a large recipient herd
EMBRYO TRANSFER	non-surgical	A.I.S.	Dys 7 - 10 best results	not available	reduces cost

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