HISTORICAL REVIEW OF THE LSU DAIRY IMPROVEMENT CENTER

The history of the Dairy Improvement Center covers some 71 years and involves much of the history of LOUISIANA ANIMAL BREEDERS COOPERATIVE, INC (LABC) and artificial insemination (AI) in Louisiana. The very first AI unit in the state was started in Ruston, Louisiana in 1946. This same year (1946) the state Legislature appropriated funds and instructed the Dean of the LSU College of Agriculture to initiate a state-wide livestock improvement program including AI of cattle. Following this, the Dairy Improvement Center was established on the LSU campus and began operating on October 15, 1947 and beginning a program in bull management and various aspects of semen processing.

The Louisiana Artificial Breeding Cooperative, a companion Cooperative organization, was organized July 16, 1947 by an interested group of farmers. The main purpose of the Cooperative was the improvement of livestock through AI and in accomplishing this goal, it has worked closely with the LSU College of Agriculture, the Dairy Department and Extension Service. The first semen shipment was made on October 15, 1947 to 15 local breeding circuits of the Cooperative. A total of 12,653 cows were inseminated during the first year and by 1958 there were 42 local breeding circuits breeding over 44,000 cows.

Offices, bull housing and laboratory facilities were constructed by the University on a 30 acre tract at LSU to house the jointly operated AI program carried out by the Dairy Department and LABC. This facility was later named the T.E. Patrick Dairy Improvement Center in honor of its long-term manager, Dr. T.E. Patrick.

From the dedication and leadership provided by Dr. Patrick, J.A. Shealy, Drs. D.M. Seath, A.H. Groth, Cecil Branton, H.W. Anderson, J.B. Frye, Jr., J.G. Lee, E.W. Neasham and S.E. McCraine, the AI program took root and developed.

Early work showed that extended semen could be cooled to 5 degrees C and shipped by parcel post with only a slight reduction of quality (167). It was also shown that seminal quality was better maintained when cooling and dilution was carried out immediately (167). Work continued in semen processing techniques to show that high dilution rates resulted in comparable fertility rates with less diluted semen (53).

Initially, there were enough bulls purchased and housed to supply the semen needs for the AI program. Most of these were owned by the University. As the program progressed, the Cooperative purchased and owned the dairy and most of the beef sires used in the program as of the late 1970's.

Additional studies showed a dramatic increase (16.3%) in non-return rate due to the addition of streptomycin and penicillin. As a result of the effects of antibiotics, dilution rates were reevaluated showing that 12 million motile spermatozoa per ml of diluted semen produced the highest non-return rate of the dilution rates investigated. Examination of the association of several seminal quality tests with fertility expressed by non-return rates showed that no one criterion could accurately and reliably predict fertility. Further work indicated that deposition of semen into the uterine body provided best fertility.

In late 1954, work was initiated in the low temperature storage of bovine semen. Early work showed a slight decrease in motility of glycerolated diluted semen, stored at -76 degrees C for up to 120 days with no significant decline in field fertility for frozen semen. Glycerolated homogenized milk was compared to

yolk-citrate as a semen extender for non-frozen semen which indicated a slight advantage for the milk after the semen had been stored for 4 days.

After the advent of storing frozen semen in liquid nitrogen at -196 degrees C, work was done to investigate the effect of various gases on the livability and fertility of bovine semen. It was found that flushing semen ampules with nitrogen improved livability and slightly increased non-return rate. It was also found that semen collected in the spring had better quality and higher fertility than that collected during other season.

Further studies were conducted to optimize freezing techniques of semen in 1 ml glass ampules. It was found that semen could be frozen in liquid nitrogen vapor with 7% glycerol, utilizing a 12-hour equilibration time. Other work was done to establish the relationship of several seminal quality measurements to fertility. It was seen that head size, although associated with motility, could be used in predicting fertility (140) and that motility assessed after incubation would be useful in predicting non-return rate. Later work related sperm motility with aldolase, B-glucoronidase, and acrosome morphology as detected by staining techniques.

Extender compositions were studied resulting in the development of the LSU Extender No.1 which improved fertility on the average by 3.6% . The advent of plastic straws, as a package, necessitated work to establish a proper processing technique. Methods were established for equilibration and thawing of 0.3 ml U.S. plastic straws.

LABC's primary purpose remained to be livestock improvement by making available outstanding beef and dairy sires through AI. A number of special services are offered by LABC including technician and field service programs, herd analysis, AI training schools, custom collection, freezing and storing of semen and young sire sampling program. With the increase in do-it-yourself insemination, quality control of semen becomes increasingly important due to the fact that non-return dates became less available. Also, the farmer-breeder is more likely to have semen in his field refrigerator from many different processors and in various packages. With these facts in mind, seminal quality tests and thawing methods were re-evaluated. It was found that motility, acrosomal integrity, and percent live sperm were all significantly related to bull non-return rates. In this study, motility was determined by phase microscopy, while acrosomal integrity was assessed with differential interference contrast optics, and percent live sperm was determined by staining techniques. Thawing methods were established for the 1 ml ampule, 0.3 ml and 0.5 ml straws.

Minimal work at this station included examination of citric acid, lactic acid, and oxygen metabolism in semen from four subhuman primates and DNase activity in rabbit epididymes. It was concluded that metabolism of the substrates studied was uniform across the species and that oxygen consumption was also similar. DNase activity was suggested to be associated with the digestion of nuclear material of debilitated spermatozoa.

Basic semen and bull physiology studies were conducted to investigate spermatozoal metabolism as influenced by colloidal dispersion states; the basic relationship between plasma progesterone levels and spermatozoal abnormalities; and the influence of sexual preparation on seminal quality parameters. Bull management studies were conducted in relation to type of exercise and type of hay (alfalfa, lespedeza, or clover-grass) fed to dairy bull. These studies indicated that additional forced exercise over free access to pasture or type of hays had no benefit in terms of semen produced, seminal quality, or subsequent fertility. Along with these studies, the frequency of collection was investigated, and it was demonstrated that mature dairy bulls could be collected every four days without detrimental effects on seminal quality or quantity. In order to obtain maximum semen production, work was conducted to investigate the role of sexual excitement in seminal quality and quantity. It was noted that sexual stimulation increased total cells harvested per ejaculate. Ambient

environment was shown to be associated with increased systemic responses and a slight decrease in percent normal motile spermatozoa with a consequent decrease in usable ejaculates. However, those used did not have reduced fertility. During a period from 1960 to 1965, investigations were carried out concerning the feeding of protamine and vitamin A to bulls. The feeding of protamine did not show any benefit in seminal quality or systemic response. Vitamin A produced varied responses on two occasions. The influence of light, temperature, and humidity on bull systemic and reproduction response was studied. It was found that light had the greatest influence on usable semen and that systemic serological responses were unaffected by the measured variable. Zone cooling of the head and neck of dairy bulls resulted in a decrease in percent primary abnormal spermatozoa, improved total semen volume, and lowered respiration rate.

As the program developed, there was an apparent need to have strong associations with other AI organizations in order to provide semen exchange programs in all breeds to meet the genetic needs of the LABC member-customers. The first of these associations was the United Semen Exchange in the early 1960's followed by the NAL or Affiliated Breeders Program in 1969 through 1985. Since 1986 a Federation of LABC, Atlantic Breeders Cooperative and Eastern AI Cooperative has been very successful in exchanging semen and sharing other resources including a marketing partnership (Federated Genetics).

Dr. Patrick remained the Director of the Dairy Improvement Center and Manager of LABC from its inception until March 1977. There were several assistant managers during that same period such as Howard Kellgren, Dick Elverson, Larry Guthrie, and Dr Arnold Baham, who became the Director and Manager upon Dr. Patrick's retirement. In February 1977, Dr John E Chandler was hired as Assistant Professor and Assistant Manager of the cooperative. In addition to the Assistant Manager duties, Dr. Chandler acquired Dr. Patrick's duties of teaching senior level physiology course as well as guiding graduate students with their research and studies. Other key personnel were Robert Dragland, Gavin Pritchard, R.J. Smith, Danny Gant, Bobby Fair and James Chenevert to name a few.

Although there continues to be a strong, Cooperative effort between LABC and the Louisiana Agricultural Experiment Station in research and educational efforts under the direction of Dr Chandler, much of the financial responsibility for operating the ongoing AI program was transferred to LABC over 35 years. The land and building facilities owned by the LAES and used by LABC are provided at no charge. Animals and other resources owned and served by LABC are made available to the University for research and educational efforts. This highly successful working arrangement was documented in a Cooperative Agreement in 1991.

Research involved the use of image analysis of enhanced contrast videomicroscopy for comparison of bull sperm and leukocyte chromosome areas as related to gender. Research was the first to show that differences in the head area of normal bull sperm are associated with the presence of the X- or Y- chromosome. Thus, discrimination of sperm head areas measured with videomicroscopy may be used to evaluate sex of bovine spermatozoa. This had application in the evaluation of the efficacy of semen sexing methodologies. Additionally, the videomicroscopic technology in conjunction with in vitro fertilization techniques was used to investigate the relationship between primary sperm abnormalities and sperm chromosome number and structure. The objectives were to further understand how the abnormalities in sperm head shape are involved in reduction in fertilization efficiencies both in domestic animals and humans. Work was the first to show that videomicroscopy and image analysis technologies can be used to differentiate for the integrity of the bovine acrosomal membrane. Work showed that, by using videomicroscopy, morphological measurements can be used to readily distinguish

certain types of sperm abnormalities from each other and from normal cells.

Research was published of the heritability of spermatozoal acrosomal integrity of Holstein bulls. This characteristic is the single most important predictive measurement of fertility of bulls used in artificial insemination. Also, the heritability of other seminal quality characteristics were published. Heritability of all characteristics was of sufficient magnitude to allow for genetic selection to improve seminal quality and consequently fertility of bulls used in artificial insemination. Request for this information have been both national and international.

A linear quality score based on the multivariate techniques that use the correlative nature of five seminal quality parameters was used in semen culling decisions. This technique was being used by members of the artificial insemination industry to identify and keep high quality semen from their production bulls. The linear quality score is being used as a selection index to evaluate quality semen production of young sires being brought into artificial insemination programs.

First to publish acrosomal integrity characteristics of the dairy goat and to evaluate the efficacy of processing goat semen under normal processing conditions incurred in the artificial insemination industry in the United States.

The last definitive work on thawing bovine semen packaged in French and Centennial straws, and glass ampules was published. This work was the basis for the recommended thawing procedures adopted by the National Association of Animal Breeders. Optimal procedural techniques for processing bovine semen using egg yolk - glycerol extender and the 0.5 ml French straw was established.

Our research was the first to show that differences in the head area of normal bull sperm are associated with the presence of the X- or Y- chromosome. Endeavors to separate bull sperm based on head size and using videomicroscopy to evaluate for the presence of the X and Y chromosome. Additionally, we are using the videomicroscopic technology in conjunction with in vitro fertilization techniques to investigate the relationship between primary sperm abnormalities and sperm chromosome number and structure. Further understanding of how sperm head abnormalities are involved in reduction in fertilization efficiencies both in domestic animals and humans. This work is being done in conjunction with Dr. Brenda Bordson, Reproductive Resources Inc., Kenner, LA.

Later work demonstrated that the probabilities of obtaining a male or female offspring at each breeding in cattle and in swine is not the believed 50%. We used the polymerase chain reaction (PCR) DNA analysis technique as well as calving and farrowing records to show the chances of getting 50% male offspring at any one mating ranges from less than 20% to above 80%. This discovery could be used in both of these livestock industries to increase the efficiency of production of meat and milk. There are also implications in the assisted reproductive technologies in human medicine.

The LABC program has served its member-customers well for 71 years with the assistance and support of the LAES and its University facilities. Changes in technologies, services and affiliations have occurred, all of which have been beneficial in meeting the genetic needs of the members and customers that both the LAES and LABC work to serve.

A merger of the Federation of LABC, Atlantic Breeders Cooperative and Eastern AI Cooperative was passes by the membership in March of 1996. LABC was dissolved and the Genex Inc. (Ithaca, NY) became the source of semen services for Louisiana on April 1, 1996. After the dissolution of LABC, Genex Inc. continued to operate a custom semen collection facility at the Dairy Improvement Center for the Louisiana beef and dairy producers. Also, Genex Inc. continued to cooperate in the teaching and research activities in the field of AI and physiology of reproduction. As of June 1, 2015 (?) Genex Inc. sold the custom collection business to Continental Genetics of

Livonia, Louisiana. Management of the Dairy Improvement Center was assigned the Aquatic Germplasm and Genetic Resources Center a research group located at the Dairy Improvement Center of the Louisiana State University Agricultural Center.