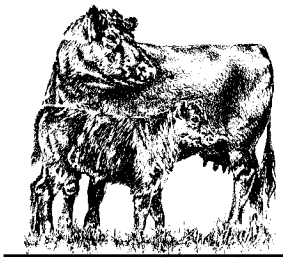
Western Beef Resource Committee

Fourth Edition



Cattle Producer's Handbook

Reproduction Section 460

Advances in Reproductive Biotechnology

Dean Hawkins and Kim Kane
New Mexico State University

Reproductive rates determine the success or failure of most animal agriculture enterprises. Since the advent of frozen semen and artificial insemination (A.I.), scientists have attempted to manipulate reproductive rates of mammals, sometimes successfully, often not. The past decade has resulted in phenomenal expansion of reproductive techniques, some with direct application to livestock producers. This paper will briefly cover developments and modifications of existing reproductive management technology and techniques that may (or may not!) have practical implications in the future.

Artificial Insemination

The ability to select superior sires is the primary way many cattle producers have improved their herd genetics. Semen freezing and insemination procedures have changed minimally in the past two decades. In its current form, A.I. of cattle has been around for over 50 years. However, pregnancy rate averages have not dramatically improved and, at best, remain around 50 and 70 percent for timed A.I. and heat-detected breeding, respectively. Limitations in estrus synchronization and herd fertility account for inadequacies in pregnancy rates.

Currently, more than 15 synchronization protocols are available (Geary 2003). The goal of scientists is to develop protocols that minimize costs and number of times cattle are handled, yet increase pregnancy rates to A.I.

Situations exist on every ranch that probably precludes the use of a universal synchronization protocol. Prostaglandin F_{2a} (PGF_{2a}) is the most widely used hormone for estrus synchronization. However, manipulation of the estrous cycle with PGF_{2a} requires that the beef female be between days 6 and 16 of the 21-day estrous cycle.

Traditionally, PGF_{2a}-based protocols required detection of estrus (heat), which is not always feasible or practical to ranchers. Newer protocols (Geary 2003) that induce ovulation have proven beneficial and gained acceptance. These protocols can be used with or without heat detection.

The basic principle for most of these is the use of gonadotropin releasing hormone (GnRH) to induce ovulation of ovarian follicles. The resulting corpus luteum is then regressed with PGF_{2a}, and a new follicular wave is initiated. The resulting follicle is either induced to ovulate with an additional injection of GnRH, and cows are mass inseminated, or the follicle is allowed to ovulate spontaneously and cows bred after detected heat. These protocols work well with cows, yet their use in heifers is less effective. An added benefit for the ovulation induction protocols is that some non-cycling cows will be induced to cycle, thereby reducing postpartum anestrous periods.

Recently, CIDR's (controlled internal drug releasing device) have been approved for use in the U.S. CIDR's are impregnated with the steroid hormone progesterone and placed in the vagina. Progesterone is normally released from the corpus luteum, which forms after ovulation. In the absence of pregnancy, the corpus luteum regresses at the end of the estrous cycle, progesterone concentrations decline below a threshold level, and a new estrous cycle begins. By using CIDR's, the concentration and duration of progesterone is controlled by the producer, thereby allowing the decline in progesterone to occur at a precisely controlled time, facilitating use of A.I.

In Vitro Fertilization and Intracytoplasmic Sperm Injection

In vitro fertilization (IVF) is the fertilization of an oocyte (egg) by sperm in a culture dish outside the body. This procedure is commonplace in human fertility clinics and has been used to produce animal pregnancies as well.

The procedure most commonly involves aspiration of oocytes from ovarian follicles via vaginal ultrasonography. An ultrasound transducer is placed in the vagina, and an oocyte pickup needle is used to perforate the vagina. While viewing follicle(s) on an ultrasound monitor, the needle is guided into a follicle and low vacuum pressure applied. The oocyte is retrieved from the follicle, placed