

## **REPRODUCTIVE RESEARCH IN DAIRY CATTLE AT KSU**

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### **Summary**

Research in reproductive physiology and breeding management of dairy cattle at Kansas State University has the following objectives: 1) to better understand those factors that influence the reestablishment of ovarian function, estrous cycles, and fertility after calving and 2) to apply that knowledge to areas of management in which pregnancy rates and calving intervals can be improved in dairy herds. Our past efforts have included 1) pioneering research into the applications of gonadotropin-releasing hormone (GnRH) at the time of insemination and early postpartum as a prophylactic treatment for inducing estrous cyclicity; 2) application of treatments utilizing prostaglandin F<sub>2a</sub> (PGF<sub>2a</sub>) for breeding management of open cows, estrous induction for first services, and postpartum therapy for cows with periparturient problems; 3) utilization of progesterone-releasing intravaginal devices (PRIDs) to induce estrus and enhance fertility; 4) studies aimed at understanding estrous behavior, including the influence of the thyroid gland; 5) efforts to understand the influence of progestogens on the function of the corpus luteum; and 6) estrous synchronization of heifers and cows utilizing PGF<sub>2a</sub>.

### **Introduction**

Reproductive performance affects average milk produced per day of herd life, the number of potential herd replacements, and the longevity of the cow in the herd. All of these factors determine efficiency and profit. Because reproductive events culminate in an "all or none" endpoint, a cow or heifer is either pregnant or open. Therefore, reproductive failure causes frustration for dairy managers.

Our reproductive research is aimed at gaining better understanding of the factors involved in preventing reproductive failures. This involves studies that help us understand the physiology of reproduction, as well as manipulating and managing these factors to minimize reproductive loss. In practice, this must translate into the discovery of new principles and the integration of those principles into well-designed programs for breeding, preventive herd health, and reproductive management. Ultimately, this leads to minimal involuntary culling of problem breeders by maintaining healthy, profitable cows in the herd. Despite our best efforts, some culling will inevitably occur because of the complex nature of reproductive physiology.

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## **Estrous Behavior**

We have investigated recently the role of the thyroid gland in reproductive behavior. According to the literature in the 1950's, removal of the thyroid gland from the cow resulted in continued normal development of the egg and follicle (i.e., normal oogenesis and folliculogenesis) during the estrous cycle, resulting in fertile ovulations. However, cows without a thyroid gland did not express heat (no estrous behavior). One of the biggest problems we face today on the dairy farm is catching cows in heat. We hypothesized that high-producing dairy cows today might be difficult to catch in heat because of physiological reasons such as hypothyroidism, metabolic imbalances, and negative energy balance (inability to consume sufficient feed to meet the requirements of milk produced), in addition to simply not observing cows often enough to catch more heats. Our experiments thus far lead us to conclude that cows without intact thyroid glands can express estrus in response to estrogen. This suggests that the thyroid gland is not essential for the cow to show heat.

## **Programmed Weekly Inseminations**

Over the last 9 yr, we have tested many systems to determine the benefit of utilizing the prostaglandins (prostaglandin F<sub>2a</sub>: Lutalyse® and Estrumate®) to control the onset of estrus (synchronized heats) for the convenience of management goals and use of labor. We reported earlier the benefit of utilizing prostaglandin for dairy cows with silent heats (1984 Dairy Day, KAES Rep. Prog. 460, pp 28-30). These are cows that are cycling normally but are not caught in heat to receive their first service or, once bred, are not observed in heat when pregnancy fails to occur. These cows should be palpated by the veterinarian during his regular PPHP herd visit to determine if they have a functional corpus luteum (CL). This also can be accomplished by testing a sample of their milk to determine if the progesterone concentration is high (indicating a functional CL). Administering one of the prostaglandins resulted in these cows being bred and becoming pregnant 2 to 3 wk sooner than untreated cows. The success of this treatment, depended on our breeding cows at 72 and 96 hr after prostaglandin treatment when we failed to catch them in heat. These cows either show weak heats or we had difficulty catching them in heat when they truly were estrual. Therefore, insemination at 72 hr and re-insemination at 96 hr achieved a pregnancy rate of 45%.

We further demonstrated that using prostaglandin on Monday mornings allows us to breed cows during the 5-d work week, with most cows showing heats on Thursdays and Fridays. We are doing further work to test this management system utilizing milk progesterone evaluations on cows eligible to be injected with prostaglandins on Mondays and inseminated during that week.

## **Fertility Applications**

We have shown that cows with periparturient problems will have improved fertility when injections of gonadotropin-releasing hormone (GnRH or Cystorelin®) are given around 2 wk after calving or when a prostaglandin is given about 4 wk after calving (1985 Dairy Day, KAES Rep. Prog. 484, pp 40-42). Both hormone injections appear to increase early cycling activity and promote better uterine involution.

Administering GnRH to repeat-breeder cows increased pregnancy rates in several of our studies (1987 Dairy Day, KAES Rep. Prog. 527, pp 24-25 and 1988 Dairy Day, KAES Rep. Prog. 554, pp 16-18). We continue to recommend its use for cows at third and fourth services. Injections of GnRH given at the time of those services increased pregnancy rates by 8 to 12 percentage points (15 to 20% improvement). We are currently doing more work with GnRH in repeat breeders to determine its minimum effective dose, as well as its influence on the secretion of various important reproductive hormones that are essential for normal fertility.

We are pursuing new studies utilizing very potent analogs of GnRH that seem to be effective in increasing pregnancy rates of heifers when the analog is administered about 2 wk after breeding. We have observed a dose response in over 400 heifers tested and will continue these studies in lactating dairy cows in the future.

We have done some work with the hormone progesterone. We found that it effectively synchronizes estrus, improves estrous expression and reduces conception intervals (1987 Dairy Day, KAES Rep. Prog. 527, pp 26-28). We have used a vaginal device that releases progesterone, which then is absorbed by the vaginal wall. We are now testing its effects on pregnancy rates of cows when it is administered after insemination during the first 2 to 3 wk after estrus.

## **Corpus Luteum Function**

We are conducting experiments to understand better the factors controlling the onset of estrous cycles after calving and the function of the first corpus luteum that forms after ovulation. We have observed that administering progestogens early after calving will normalize the estrous cycle (1988 Dairy Day, KAES Rep. Prog. 554, pp 19-21). We are doing more work to understand the effect of progestogen treatment on ovarian follicular development, ovulation, and formation and function of the corpus luteum.