A Comparison of Pregnant Mare Serum Gonadotropin and P.G. 600® to Improve Reproductive Efficiency in Sows

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A COMPARISION OF PREGNANT MARE SERUM GONADOTROPIN AND P.G. 600® TO IMPROVE REPRODUCTIVE EFFICENCY IN SOWS

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In Agriculture

By
Evan Michael Tate
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A COMPARISON OF PREGNANT MARE SERUM GONADOTROPIN AND P.G. 600® TO IMPROVE REPRODUCTIVE EFFICIENCY IN SOWS

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An initial thought came to my mind when contemplating what to write in this particular section and that is, "A person is only as good as the company he or she keeps." I am honored to have such quality family, friends and professional staff. This thesis would have been a daunting task if it were not for the numerous individuals who have supported me throughout my graduate career.

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A COMPARISON OF PREGNANT MARE SERUM GONADOTROPIN AND P.G. 600® TO IMPROVE REPRODUCTIVE EFFICIENCY IN SOWS

Abstract

Evan M. Tate  
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Pages 4-5

Directed by: Drs. Gordon Jones, David Stiles, Elmer Gray

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Three hundred and nineteen sows were utilized to study the effects of pregnant mare serum and P.G 600 on reproductive efficiency. Sows were randomly allotted to treatments.

Sows were evaluated for age (# of parities), breed composition and body condition score. Three sows who shared all three fields in common were randomly treated with one of three treatments the morning after weaning:

1. (S) Controls: 5ml of Sterile Saline Solution 0.9%
2. (M) Treatment (PMSG): 12ml of Pregnant Mare Serum
3. (P) Treatment (PG600)® 5ml of P.G. 600 (Intervet America Inc., Millsboro, DE)

No differences were observed for total number of pigs born among treatments (P>.05). Neither parity, body condition or breed composition had a significant influence on total number born. However, treatments of pregnant mare serum and P.G. 600 to controls resulted in significantly shorter wean to estrus intervals (P<.0002 vs. P<.0001) than sows in the control group respectively) from weaning to estrus. Additionally, P.G. 600 treated sows had shorter weaning to estrus intervals than PMSG treated sows (P<.0802).
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Chapter One
Introduction

Reproductive failure continues to be the leading factor for producers to consider when deciding which sows to cull from the herd. Anestrous females are unproductive and represent serious economic loss. Efficient commercial swine units should obtain at least two litters farrowed and 22.21 piglets weaned per mature female each year, but that level of productivity is not achieved in many herds (Stalder, 2007). Anestrous sows are defined as problems if they do not exhibit estrus within 14 d post weaning or when gilts have not been mated by eight months of age (King et al., 1985). The anestrous condition occurs in sows due to season, lactation length, parity (King et al., 1985) and body condition (MacLean, 1968, 1969; Reese et al., 1982a, 1984).

To aid in combating factors which may inhibit estrus, swine producers now have the option of the administrating of exogenous forms of lutenizing hormone (LH) and follicle stimulating hormone (FSH). In the sow, human chorionic gonadotropin (hCG) imitates LH and FSH may be imitated by equine chorionic gonadotropin (eCG). P.G. 600 (Intervet America Inc., Millsboro DE)is a commercially available product which combines 200 IU of hCG and 400 IU of eCG to be used as an exogenous source of the two gonadotropic hormones. P.G. 600 is a labeled for use in prepubertal gilts and sows at weaning. It is supplied in freeze dried form with sterile diluents for reconstitution.

In gilts and sows, the action of serum gonadotropin is similar to the action of FSH, which is produced by the animals’ anterior pituitary gland. It stimulates the follicles of the ovaries to produce mature ova (eggs). Mature ova then secrete estrogens which promote the outward signs of estrus (heat). The action of chorionic gonadotropin in gilts and sows is similar to the action of LH, which is produced by the animals’ anterior
pituitary gland. It causes the release of mature ova from the follicles of the ovaries (ovulation), and it promotes the formation of corpora lutea, which are necessary for the maintenance of pregnancy once the animals have become pregnant.

The combination of serum gonadotropin and chorionic gonadotropin in P.G. 600 induces a fertile estrus in most prepubertal gilts and weaned sows 3 to 7 days after administration (Schilling and Cerne, 1972; Britt et al., 1986; Bates et al., 1991). The animals may then be mated or, in the case of gilts, mating may be delayed until the second estrus after treatment. Kutz, (1997) working with the same confinement operation as the current study reported that the administration of 60mg of PMSG produced a farrowing rate significantly higher (P<.0001) than control sows (100 vs. 63.46%, respectively) in the summer months. Since the completion of the 1997 study, the consistency of PMSG has become questionable. Furthermore, its economic benefit for producers who use it during cool season months has not been appropriately elucidated in the literature.
Nonproductive Days

Nonproductive days occur for sows that are not pregnant or are not lactating, and include weaning to estrus interval (WEI) (Stein, 1992). This results in a lowered farrowing rate (Knox et al., 2000). King et al., (1985) stated that anestrous females are totally unproductive and represent a serious economic loss when more than an occasional individual is encountered in any herd (King et al., 1985). Anestrus sows are considered problems if they do not exhibit heat within 14 d post weaning. Likewise, gilts are considered problems if their heats go undetected and they are not mated by eight months of age (King et al., 1985).

Factors which may cause the occurrence of nonproductive days as cited by Knox et al., (2000), include season, (Hurtgen and Leman, 1980; Love et al., 1993) lactation length, parity (Hurtgen and Leman, 1981; Koketsu and Dial, 1997; Koketsu et al., 1997) and body condition (MacLean, 1968, 1969; Reese et al., 1982a, 1984). Sows weaned during periods of high ambient temperature exhibit estrus later than the typical 4 to 7 d post weaning period (Hurtgen and Leman, 1979; Britt et al., 1983). During hot weather, sows eat less, lose more total weight and backfat, and take longer to return to estrus after their offspring are weaned (Armstrong et al., 1986; as cited by Bates et al., 1991; McGlone et al., 1988).

Endocrinology

Narasimha and Suryaprakasam (1991) noted an improved synchronization, higher
percentage of estrus induction and more noticeable estrus behavior resulting from the administration of PMSG which causes follicles to mature and an endogenous release of estradiol. An increase in production and release of ovarian steroids was noted in sows that experienced follicular growth due to the administration of PMSG (Zeicik et al., 1987). In Simmental cattle, treatment with PMSG provoked large increases in estrogen concentration (Bono et al., 1991). Kutz (1997) suggested that the previous findings suggested a better reaction to preovulatory LH surges causing an improved response to follicular growth. An extended half-life of PMSG is believed to be antagonistic to its effectiveness as an agent to superovulate the ovary once it is placed in circulation (Echternkamp, 1978; Moyaert et al., 1985). After estrus is induced, Kirkwood and Thacker (1992), noted a prolonged period of elevated estradiol concentration which is indicative of follicular growth. However, an interference with normal ova, sperm transport and fertilization (Kirkwood et al., 1991) essentially causes complications and/or setbacks in embryo development as noted by Hunter (1966) and cited by Kutz (1997). Zeitoun et al., (1991) noted that the use of antiserum with PMSG to combat the previous, caused treatment sows to be comparable to control sows showing no benefit to injections.

Gonadotropin Secretion

Sows rarely show estrus or ovulate during lactation unless lactations exceed 6 to 8 weeks. (Burger, 1952). In the sow, LH and FSH secretion are suppressed by suckling of piglets (Britt, 1996) and ovulation during lactation appears to be inhibited due to limited LH secretion that can only be increased by weaning or perhaps reduction in suckling intensity of piglets (Stevenson and Britt, 1980). Rozeboom (2000) stated that this lack of suckling stimulus is needed for three days in order for postweaning LH to be secreted and
carry out normal activity. Cox and Britt, (1982) cited that the removal of piglets at weaning causes the hypothalamus to secrete more gonadotropin releasing hormone (GnRH) and the release of GnRH causes pulsatile LH secretion from the anterior pituitary (Shaw and Foxcroft, 1985; Cox and Britt, 1982). Furthermore, weaning litters after lactations of 3 to 5 weeks resulted in increased ovarian follicular growth (Palmer et al., 1965; Crighton and Lamming, 1969; Cox and Britt, 1982; Dyck, 1979), and increased estradiol and gonadotropin secretion (Dyck et al., 1979; Stevenson et al., 1981; Cox and Britt 1982; Edwards and Foxcroft, 1983). These changes are temporarily related to increases in anterior pituitary concentration of LH and hypothalamic concentrations of GnRH (Cox and Britt, 1982). Onset of fertile heat and ovulation results from these temporary changes (Bates et al., 1991).

Serum LH concentrations in sows increased as lactation advanced and appeared to be more episodic with an increased frequency of small LH peaks during late lactation as ovarian follicles increased in number and diameter which suggests that limited amounts of LH and FSH are secreted during lactation (Stevenson and Britt, 1980). Serum LH levels do not increase dramatically until 24 hours before estrus due to no noticeable increase being noted following weaning as circhoral release of GnRH in sows occurred at 135.0 ± 9.4h after weaning (Stevenson and Britt, 1980; Palmer et al., 1965,Dyck et al., 1979; Armstrong and Britt, 1985). Sows which were weaned after a 21 to 28 d lactation period and possess good body condition usually returned to estrus within 7d (Estienne and Hartsock., 1998).

Exogenous gonadotropins have been administered to stimulate ovarian activity due to the suppression of gonadotropin secretion and ovarian inactivity (Knox et al.,
Based on data available, the ovary appears to be responsive to stimulation by gonadotropins administered exogenously during lactation (Creighton, 1970), but does not appear to be actively secreting significant amounts of steroids until after weaning (Stevenson and Britt, 1980). Ovaries of anestrous sows slaughtered one or more months after weaning were usually small and did not contain corpora lutea (Dyck, 1971; Dyck, 1979; Svaigre et al., 1972).

Body Condition

A sow must overcome the effects of suckling on the neuroendocrine systems as well as the metabolic demands placed on tissue reserves during lactation in order to return to a fertile estrus (Clowes et al., 1994). Poor fertility after weaning often may be the result of insufficient nutrition and sows entering a catabolic state of existence (Aherne and Kirkwood, 1985; King, 1987; Baidoo, 1992 a,b). Parity 1 and 2 sows became progressively more catabolic during lactation to meet demands of milk production (Cole, 1989, as cited by Clowes et al., 1994).

Mobilization of body reserves allows lactation to occur with some independence from any limitation in nutrient supply. Thus, depletion of maternal reserves may eventually compromise current lactation and subsequent reproduction (King, 1989; Martin, 1989; Jones and Stahly, 1999a, b). Maintaining adequate body tissue reserves throughout a sow’s lifetime is thought to be important to maximize herd productivity (Young et al., 2004). Gaughan et al. (1995, 1997) and King (1989) reported that body composition does influence reproductive performance. It has also been noted that changes in body composition were associated with an impaired state of reproductive performance (Brooks et al., 1975; Bereskin and Frobish, 1981) as most reproductive hormones are
made from a base of fat molecules (Johnson et al., 2006). Furthermore, the body condition of sows in modern pig herds has become an issue of considerable importance because of the economic pressure to achieve optimal production targets (Maes et al., 2004). An increase in culling rates approaching 60% of the sow herd per year has been noted (Esbenshade et al., 1986).

Reproductive efficiency is measured as pigs/sow/year and it has been affected by small litter size, post weaning anestrous and failure to conceive (Esbenshade et al., 1986). Furthermore, body condition is associated with reproductive efficiency (Coffey et al., 1999). Sow body condition scores (BCS) can be used to determine sow feeding levels and range from 1 to 5 (Coffey et al., 1999). A condition score is applied to sows based on the ease, or difficulty of detecting bones at various pressure points (Coffey et al., 1999). Incorrect body condition (BCS 1 or 2, excessively thin or thin) (Johnson et al., 2006) or being overly fat (BCS 4.5 or 5) (Johnson et al., 2006) has been a contributing factor to post weaning anestrous (MacLean, 1968, 1969; Reese et al., 1982a, 1984) and loss of litter size in multiparous sows (Brooks, 1982).

Most of the effects of energy and protein supply on reproductive performance and longevity are associated with extreme (high and low) variations of body weight or fat reserves (Dourmad et al., 1994). Close and Cole (1986) suggested that these variations occur on a short term basis or as subtle fluctuations over a long period of time. Maintaining sows in proper body condition (body condition score 3 as defined by Johnson et al., 2006) throughout their lives can lead to more consistent reproductive performance (Coffey et al., 1999). Sows should enter the farrowing crates with adequate fat reserves to sustain them through lactation (Johnson et al., 2006). Inadequate control of
sow body condition can lead to dystocia and poor reproductive performance as well as high culling rates (Coffey et al., 1999). A study of Large White sows showed that depth of backfat at mating was positively related to lifetime productivity (Gaughan et al., 1995). Whittemore and Yang, (1989) concluded that a depth of 10mm at the P2 site was the appropriate amount of backfat at weaning. Unfortunately, Hughes and Smits, (2002) as cited by Young et al., (2004) and Young et al., (2001) reported that BCS and backfat have been poorly associated with each other.

Reproductive traits are lowly heritable (<.15) (NSIF, 1996) and are highly influenced by the environment, which includes management of replacement females (Stalder et al., 1999). Henry and Etienne, (1978) as cited by Dourmad et al., (1996) stated that the amount of maternal gain in pregnant sows is highly dependant upon the level of energy fed during gestation. Intake levels of energy (Kirkwood and Aherne, 1985) and protein (Murray et al., 1998) have influenced reproductive performance of gilts. According to Mejia-Guadarrama et al., (2002), high body protein reserves at farrowing may buffer the negative impact of dietary protein restriction, specifically lysine, on milk production, and may also minimize alterations in reproductive performance when protein intake during lactation is low.

Furthermore, energy intake affects weight change during gestation (Elsely et al., 1968; Baker et al., 1969; Libal and Wahlsrom, 1977) and lactation (Hitchcock et al., 1971; O’Grady et al., 1975; Varley and Cole, 1976; Reese et al., 1982b) and backfat change during gestation and lactation (Elsley et al., 1968a; Adam and Shearer, 1975; O’Grady et al., 1975; Reese et al., 1982a; Reese et al., 1984; Nelssen et al., 1983). If a sow begins to utilize reserves (fat used as an energy source, muscle used as a protein
source), she will metabolize these tissues and inherently lose body weight (Johnson et al., 2006). However, neither energy nor feed intake during lactation appeared to have influence on subsequent litter size (Elsley et al. 1968; Hitchcock et al. 1971; Varley and Cole, 1976).

Sows fed a diet restricted in energy or extremely thin at weaning experience delayed return to estrus and consequently increased WEI (MacLean, 1968, 1969; Reese et al., 1982a). Within the previously mentioned studies, sows which consumed a threshold level of 12 Mcal of digestible energy did not experience a prolonged WEI.

If the amount of feed needed to provide this quantity of ME is not voluntarily consumed by the sow and is the cause of lactational weight decline (Gatlin et al., 2001), fat addition may be one method used to manipulate the energy density of the diet to improve energy intake. Improvements in energy intake are needed due to high demands of the lactating sow (≥ 15 to 20 Mcal ME/d) (Gatlin et al., 2001).

Due to low feed intake and the requirements for maintenance and milk production, most commercial dam line sows must mobilize fat (O’Grady et al., 1985; Noblet et al., 1990) and protein reserves (O’Grady et al., 1985; Noblet et al., 1990; Clowes et al., 1998) during lactation. Clowes et al., (2003) stated that extensive protein mobilization decreases litter performance during lactation and ovarian follicular development at weaning. Sows with a greater lactation feed intake showed significantly less reduction in backfat and body weight losses, a higher litter weight gain and a reduced probability of an extended WEI (Eissen et al., 2003). In multiparous sows, energy supply should be modeled from the previous lactation and the amount of body reserve mobilized therein (Dourmad et al., 1996). The researchers suggested a threshold of 8500 kcal of
digestible energy per day during gestation should be achieved to ensure adequate restoration of body tissue.

Gatlin et al., (2001) suggested that the addition of supplemental fat to the diet of sows with poor body condition, especially those who are lean-genotype sows, increased metabolizable energy. This has decreased the severity of changes in body condition and improved performance, because dramatic changes in body weight or condition can be deleterious to reproduction (Reese et al., 1982a). Due to caloric density of supplemental fat additions into the diet, a decrease in overall feed consumption has been noted (Gatlin et al., 2001).

Bowland (1964), Lodge (1969), Buitrago et al., (1974) and Bereskin and Frobish (1981) reported that sows which gain more weight during gestation tend to lose more during lactation. Sows also continue to suffer from body weight loss after weaning (Bowland, 1964; Lodge, 1969). In a subsequent study, Bowland, (1967) suggested that loss of body water contributed to post weaning weight loss. Zoiopoulos, (1983) as cited by Esbenshade et al., (1986) stated that in addition to water loss, body tissue and protein depletion attributed to overall weight loss in the weaned sow. Other studies have shown that sows, especially primiparous sows that lose excessive amounts of weight will have extended WEI, reduced pregnancy rates and reduced embryo survival (Einarsson and Rojkittikhuh, 1993; Whitttemore, 1996).

Maes et al., (2004) reported a positive association between numbers of pigs weaned per sow and the decrease in backfat during lactation which implies that higher backfat losses were observed in sows that weaned more total pigs. Aherne et al., (1999) explained this association in that more energy is required for milk production in cases of
large litters. Maes et al., (2004) also stated that number of stillborn piglets increased with decreasing backfat thickness at the end of gestation. This outlines the fact that sows with very thin backfat levels or poor BCS at parturition should be avoided. Tokach, (1998) noted that when sows of poor body condition (due to low feed intake during the previous lactation) were provided extra feed during days 2-30 of gestation, embryonic mortality was minimized. Conversely, sows which possess good body condition and are fed too much show an increase in number of embryos lost (Tokach, 1998).

Sow body condition is critical to the overall health, welfare and productivity of breeding herd females. Stalder et al., (2006) stated that the most frequently noticed lesions contributing to high cull rates were shoulder abrasions found on 12.5% of sows within the trial. Zurbrigg (2006) stated that sows having a body condition score of less than 3 were 3.7 times more likely to develop shoulder lesions than those who had a BCS of 3 or greater. Additionally, sows that had flank to flank measurements of 97 to 104 cm at weaning increased the risk of developing lesions by 2.8% over those sows which measured 104.5 to 113.5 cm from flank to flank (Zurbrigg, 2006). However, this study showed that as body condition score increased, presence of shoulder abrasion did as well. Zurbrigg (2006) explained that the relationship between body condition at weaning and lesions may be a loss of condition associated with high milk production or inadequate energy intake during lactation. Shoulder lesions affect the welfare of sows, consumer attitudes and possibly farm economics (Zurbrigg, 2006).

Stalder et al., (2006) assessed the physical and reproductive condition of 3,158 cull sows by evaluating them for gross lesions and abnormal conditions. Observers appraised reproductive tracts, body condition, feet, shoulders, teeth and lungs. Stalder et
al., (2006) noticed that 9% of sows were found to have acyclic ovaries and the presence of gross lesion ovaries increased as body condition score decreased. Grossly cystic ovaries increased as BCS increased to 6.3% of test subjects (Stalder et al., 2006). Finally, Pneumonia was the most frequent systemic lesion observed at 9.6% and its prevalence increased as body condition score decreased (Stalder et al., 2006).

Number of Pigs Born Alive

Number of pigs per sow produced annually is maximized when pigs are weaned at 3 to 4 weeks of age and sows are bred at first post weaning estrus (Hays et al., 1978; Svajgr et al., 1974). However, with the utilization of P.G. 600, a decrease in number born alive has been noted. Bates et al., (1991) reported that subsequent litter size was reduced significantly by 0.45 pigs per litter. Other work by Estienne and Hartsock, 1998 and Kirkwood et al., (1998), showed no differences or a slight decline in number born alive. Knox et al. 2001 noted that differences in studies are expected due to season, parity, genetics, housing, and management. Even with these differences, most studies showed that P.G 600 or PMSG (gonadotropins) induced more primiparous sows into estrus when seasonal effects are most noticeable.

Stereotypically, primiparous sows have greater incidence of reproductive failure than multiparous sows. Conversely, Sechen et al., (1999) showed a linear relationship between increasing levels (0, 500, 750 and 1,000IU) of PMSG administered after weaning and subsequent litter size.

Bates et al., (2000) stated that this evidence supports the theory that either PMSG or P.G.600 administration near the natural time of estrus may increase litter size due to P.G. 600 treated sows were more likely to farrow a subsequent litter than controls if
conventionally weaned (84.4 vs. 71.3%; respectively).

Parity 3 through 6 sows weaned earlier did not differ significantly in litter size from controls (64 vs. 72.9%; respectively). These findings may conflict with other results due to sows in this study being weaned in the fall and winter rather than the summer months (Bates et al., 2000). Furthermore, number born dead increased for P.G. 600 treated sows (Bates et al., 2000) which is consistent with findings of Zaleski and Hacker (1993); Leenhouwers et al., (1999) stated that litter size increases, number of stillborns increase.

Variations in Reproduction due to Season

Onset of estrus after weaning is often delayed in primiparous sows compared to multiparous sows and in sows weaned during summer and early fall compared to sows weaned during other seasons (Britt et al., 1983). During July to October, the proportion of sows in estrus within seven to ten days after weaning decreased by 10 to 35% (Hurtgen and Leman, 1979; Britt et al., 1983; Cox et al., 1983) and rebreeding performance of primiparous sows was 20 to 30% below that of multiparous sows as conception rate at first estrus declined from April through July (Britt et al., 1983). Wettemann and Bazer (1985) stated that both male and female pigs who are submitted to warmer temperature are likely to exhibit lowered reproductive efficiency.

Due to minimal sweating in the pig, both boars and gilts increase respiratory rates to enhance evaporative cooling. Increased temperature acting upon gametes, embryos or uterine function is associated with lowered reproductive efficiency. In gilts exposed to higher ambient temperatures, an increase in embryonic mortality and decrease in conception rates has been observed (Warnick et al., 1965; Tompkins, Heidenrich and
Stob, 1967; Edwards et al., 1968; Omtvedt et al., 1971). Furthermore, heat stress alters the endocrine system. Armstrong and Britt, (1985) noticed that hypothalamic GnRH and anterior pituitary LH content were higher after weaning during the spring than during fall. Summer infertility and extended rebreeding interval are attributed to the season in which pigs are weaned (Reese et al., 1982a). Britt et al., (1983) cited previous research that pigs weaned in late summer or autumn resulted in longer rebreeding intervals than weaning during other seasons. However at the same time, work has been completed to suggest that rebreeding interval is longer during the winter and spring seasons. Farrowing rates are also affected by season variations as sows weaned during the summer are less likely to farrow large litters. Tubbs (1997) stated that investment on hormonal therapy is better spent for sows weaned during fall and winter due to greater environmental stress faced by summer weaned sows.

Heat Stress

Lactating sows are often exposed to ambient temperatures higher than the upper critical temperature of 22 degrees Celsius (Black et al., 1993). Sows exhibit higher respiratory rates (Black et al., 1993), reduced feed intake and lowered milk production (Schoengerr et al., 1989; Black et al., 1993; Prunier et al., 1997), in response to an increase in body temperature. In addition to the previous, inhibition of reproductive function, including delayed attainment of puberty (Flowers et al., 1989), and an increase in WEI (Prunier et al., 1997) have been noted. Omtveldt et al. (1971) stated that gilts possessed decreased conception rates and a lower number of embryos during times of high ambient temperature. This finding is consistent with a study reported by Edwards et al., (1968) that compared gilts which were heat stressed 8 to 15 d after mating to control
gilts whose ovulation rate was normal with normal estrous cycles before mating. Treated gilts had an increase in embryonic death with decreased litter size and lowered pregnancy rates at 30 d of gestation. To help explain this effect, Geisert et al., (1982), reported that between day 8 and 16 after estrus changes occur in the embryo and uterus. In heat stressed gilts that did not become pregnant, an alteration in luteal function (a non ovarian source of progesterone and progesterone clearance and metabolism) occurred. Even though pregnancy recognition occurred, embryonic mortality resulted in prolonged luteal regression.

In work done by Hallford et al., (1975), concentration levels of prostaglandin (PGF2α) were >1 ng/ml on at least one day between day 13 and 16 after estrus in 20% of control pregnant gilts, 60% of heat stressed pregnant gilts and all of control gilts not pregnant. “This finding suggests that recognition of pregnancy may be altered by heat stress and results in PGF2α being released from the uterus into the venous circulation” (Kutz, 1997).

Present literature suggests that constant elevated temperature has negative consequences on WEI. Effects of heat stress are due to metabolic and endocrine adaptations to avoid hyperthermia (Messias de Braganca et al., 1998).

Photoperiodicity

Studies of photoperiodicity have shown inconsistent results on influencing reproductive processes and values associated with efficient reproduction. Claus and Weiler (1985) stated that light programs which extend the daily light period to a constant 15-16 hours seem to be ineffective in improving reproductive characteristics of the sow but stimulate the nursing frequency of piglets and increase survival of piglets with a low
birth weight. Within the summer months of May through August decreasing light removed the seasonal increase of the WEI from 23.6 days in the control to 5.7 days among treatments (Claus and Weiler, 1985). This decrease could be related to sows milk production increasing as light increases from eight to sixteen hours per day (Mabry et al., 1982) or possibly due to pigs being stimulated to nurse more frequently (Barber et al., 1955).

Lactation Length

Sows mated on first estrus following early weaning resulted in reduced reproductive performance as measured by conception rate, farrowing rate or litter size (Self and Grummer, 1958; Moody et al., 1969, Moody and Speer, 1971). The reduction in performance was noted for lactation lengths of less than 7 days (Svajgr et al., 1974). Moody and Speer (1971) along with Svajgr et al. (1974) suggested that the earliest weaning time that will not reduce conception rate or litter size was between 13 and 24 days. Rozeboom (2000) agreed in that lactation lengths of 12-14 days hold pig health and performance benefits; however, within the same study limiting lactations to 17 days were noted for consistent breeding and reproduction performance.

Work reported by Hays et al., (1978) showed that lactation lengths of 6 to 24d had no significant effect on sows exhibiting estrus. However, within the same study the time required for sows to exhibit estrus, as evidenced by acceptance of the boar, decreased quadratically (P<.05) from (7.2d to 4.3d) as lactation length increased from 6 to 24d. These particular results were less than those reported by Svajgr et al., (1974). Fertility rate (percent of sows with fertilized ova or percent ova fertilized) was not significantly influenced by lactation length (Hayes et al., 1978). Ovulation rate in the same study,
estimated from the number of corpora lutea, was not significantly affected by the interval from parturition to weaning. The number of cystic follicles did decrease linearly (P<.05) as lactation length increased to 24 days indicating some impairment in ovarian function in the earlier weaned groups (6 and 18 days) (Hayes et al., 1978). Hayes et al., (1978) noted that fertilization rate was 90.7% for sows weaned 6 days postpartum which is consistent with other findings (Self and Grummer, 1958; Svaiggr et al., 1974).

Baidoo et al., (1992b) stated that lactation length is progressively associated with the decrease of plasma insulin and insulin growth factor 1 as well as increasing concentrations of glycerol, growth hormone and cortisol concentrations. Even though a sow’s metabolic demands have been reduced, she may still be in a catabolic state post weaning (Clowes et al., 1994). Clowes et al., (1994) stated that young sows partition nutrients to lean tissue growth instead of fat. Due to the previous, hormones associated with protein accretion increase their concentrations in contrast to those affiliated with the accretion of fat (Clowes et al., 1994). The researchers suggested that older sows move toward a more positive state as lipolysis declines rapidly. This action causes a lowered glycerol concentration at first estrus allowing metabolic signals associated with fertility and fecundity to be transmitted (Clowes et al., 1994).

Litter size and total pigs increase significantly with lactation length (Hayes et al., 1978; Moody and Speer (1971); Svaiggr et al., 1974). Unfortunately, extended lactations help induce catabolism of body tissues in primiparous sows which delays maturation of ovarian follicles (Yang et al., 2000; Clowes et al., 2003) and the oocyte (Zak et al., 1997; Yang et al., 2000). Willis et al., (2003) stated that lactation lengths greater than 14 days can increase potential second litter size of primiparous sows. However, good nutritional
management during lactation and post weaning is needed to offset adverse effects of
tissue catabolism in weaned sows (Willis et al., 2003).

Dietary Antibiotics

Feeding high levels of antibiotics during the prebreeding and early gestation
periods has resulted in improved conception rate (Jordan et al., 1961; Johnson et al.,
1964; Ruiz et al., 1968), farrowing rate (Ruiz et al., 1968;), and litter size (Dean and
Tribble, 1962; Ruiz et al., 1968), though other studies have shown only small or no
differences in these traits (Mayrose et al., 1964; Soma and Speer, 1974). Hayes et al.,
(1978) reported that the addition of oxytetracycline and neomycin improved conception
rate; however, treatment did not influence weaning to estrus interval.

Exogenous Hormone Sources

Pregnant Mare Serum Gonadotropin

Administration of PMSG on the day of (Hurtgen and Leman, 1979) or the day
after weaning is associated with shorter weaning to first service intervals, increased
subsequent total litter size and born alive litter size (Sechen et al., 1999). In heat stressed
sows, those treated with PMSG were more apt to return to estrus during the summer
months (Hurtgen and Leman, 1979; Kutz, 1997). Increases in estrus activity of up to
22.8% have been noted (Hurtgen and Leman, 1979). Hurtgen and Leman (1979)
hypothesized that PMSG given to sows at weaning would promote the onset of estrus in
fewer than seven days after weaning and reduce the incidence of anestrous periods that
extend beyond 30 days after weaning during summer-early fall months.

Furthermore sows which are lactating can be induced with an injection of PMSG
(Cole and Hughes, 1946; Heitman et al., 1956). In parity one and parity two sows, a
significant decrease in weaning to estrus interval was noted; however, no effect was noted on parity three and older sows (Sechen et al., 1999). Within the same study a trend toward larger litters was noted to be linear with dosage as it increased from 500IU to 750IU. In fact, total litter size was similar for parity one and two sows treated with 1000IU of PMSG leading researchers to suggest dosages over 750IU are not needed. Nonetheless, the number of ovulations and of embryos at day 6 and 24 of gestation has been reported to be increased with PMSG concentration of 600IU to 1200IU (Guthrie et al., 1978; Logenecker and Day, 1968).

Although PMSG can have a direct effect on embryo loss (Deneke et al., 1973; Huhn et al., 1989), sows treated with PMSG farrowed up to 2 extra piglets per litter compared with control sows as a consequence of the higher number of ovulations. Other studies found no significant increase in litter size (Hurtgen and Leman, 1979; Kutz, 1997). It is suggested that the cause was the inability of the uterus to maintain all embryos in large litters during terminal stages of pregnancy. Furthermore, super ovulated sows with more than 30 corpora had an elevated level of embryonic death (56.9%) compared to super ovulated sows with fewer than 30 corpora (26.4%) and control sows (22.9%) (Loegenecker and Day, 1968).

There has been increased synchronization of post-abortion estrus noted as well as reduced variation in the interval from abortion to estrus due to the administration of PMSG or PMSG followed 80 hours later by human chorionic gonadotropin (Martin et al., 1989). These results agree with work done by Schilling and Cerne (1972), as cited by Kutz (1997), which stated that PMSG given on the day of weaning hastens the onset of estrus.
P.G. 600

Cox et al., (1983) suggested that post weaning anestrus may be due to an aberration in brain centers within or above the hypothalamus because the hypothalamus and anterior pituitary of long-term anestrous sows respond to direct endocrine stimulation from administration of estradiol and GnRH. Additionally, ovaries of anestrous sows respond to treatment with PMSG and/or human chorionic gonadotropin (hCG) (Schilling and Cerne, 1972 as cited by Kutz, 1997; Jochle and Cerne, 1983).

The compound P.G. 600 is a hormone preparation that contains 400IU of equine chorionic gonadotropin (eCG) and 200 IU of hCG (Bates et al., 2000). When given to swine, eCG (PMSG) and hCG demonstrate the actions of follicle stimulating hormone (FSH) and lutenizing hormone (LH) (Estienne and Hartsock., 1998). The commercially available product has been approved for the induction of estrus in swine. Work done by Schilling and Cerne, 1972, as cited by Knox et al. (2000), indicated that P.G. 600 caused 90% of prepubertal gilts to express estrus within 3 to 7d post administration and of those 80% conceived and 76% farrowed (Knox et al. 2000). Tilton et al., (1995) reported that prepubertal gilts treated with P.G. 600 ovulated 7.1 more ova than controls and a higher percentage exhibited behavioral estrus. Those ova were evaluated and deemed cytogenetically normal.

A single injection of P.G. 600 induced fertile estrus in prepubertal gilts (Britt et al., 1989). Estienne et al., (2001) reported increased percentage of gilts in estrus within 7 or 28d after treatment and decreased interval to estrus compared to controls. Furthermore, P.G. 600 routinely administered to first and second parity sows during periods of seasonal anestrus, resulted in a reduced number of days to estrus and lowered the overall
percentage of sows not exhibiting estrus within 10d after weaning (Bates et al., 1991).

P.G 600 advanced the onset of estrus and ovulation and increased ovulation rate in gilts as well as significantly decreasing the average injection to estrus interval (Horsley et al., 2005). Also, anestrus sows experienced an improved return to estrus interval when treated with P.G. 600. The compound may be utilized routinely at weaning during the summer months to induce fertile estrus in first and second parity sows (Bates et al., 1991). Treatment with P.G. 600 increased (P<0.05) the percentage of sows in estrus within 7d after weaning. For the responding animals, the sows treated with P.G. 600 expressed estrus sooner than the controls (3.8±.1d vs. 4.5±.1d mean ±SE P<0.01) (Estienne and Hartsock., 1998).

Administration

Knox et al., (2000) stated that in general, induction of estrus and ovulation seem to have resulted more from subcutaneous administration of P.G. 600 than from intramuscular administration. Both modes will significantly increase the onset of estrus and ovulation in prepubertal gilts. However, Knox et al., (2000) suggested that subcutaneous administration of P.G.600 is superior to intramuscular administration for reproductive efficiency. Treatment utilizing subcutaneous administration increased the number of ovulations by 46% (P<.05). In the same study, the amount of fat at the site of the subcutaneous injection most likely decreased the response (Knox et al., 2000).

Summary

In analyzing reproductive efficiency by parameters such as total number born, weaning to estrus interval, and percent estrus detected, producers have found that nonproductive days accumulated quickly in large confinement operations. Body
condition, seasonal variation, photoperiodicity, lactation length, utilization of dietary
antibiotics, and heat stress contribute to reproductive efficiency. However, no significant
increases in total number born resulting from the administration of exogenous
gonadotropins during warm season months have been reported to overturn these
inhibitory factors.
Chapter Three
Materials and Methods

As an initial step, a local confinement swine operation of 2560 sows was visited to discuss potential reproductive problem causing agents and potential solutions to combat those. The housing allowed 96 sows to farrow each week and there was an ample supply of gestation crates and group pens within the breeding barn. This operation utilized PMSG during the summer months, administering 12ml intramuscularly. Consistency of production resulting from PMSG administration had become a question of concern due variation in production.

Based upon the current literature, this research was aimed at obtaining a better understanding of percent estrus detected, farrowing rate and number of pigs born from sows administered PMSG or P.G. 600 while being maintained in total confinement. Furthermore this study was completed during the cool season months to help fill the void in current literature.

Over five consecutive weeks during December, 2006 and January, 2007, 319 sows were treated and enrolled into the study by identifying individual tag numbers. Sows were evaluated on the basis of breed composition, parity and body condition score 1 to 2 days before treatments were scheduled. Breed composition consisted of sows being either Landrace X Yorkshire crossbred (LY) or Duroc X LY crossbred (DX). Furthermore, parity allotments were comprised of three groups, parity one sows, parity two through six sows and sows of parities greater than six. This practice was completed to minimize any interactions that could have resulted from the previous factors which could skew weaning to estrus interval and total number of pigs born. Once evaluated, sows of like parity, breed composition and body condition were randomly allotted to one
of three treatment groups:

1. (S) Controls: 5ml of Sterile Saline Solution 0.9%

2. (M) Treatment (PMSG): 12ml of Pregnant Mare Serum

3. (P) Treatment (PG600) 5ml of P.G. 600 (Intervet America Inc., Millsboro, DE)

Enrolled sows were weaned on Wednesdays at 1 pm. The next morning at 6 am, sows were administered assigned treatments subcutaneously while in the farrowing crate. After treatment, sows were moved to breeding pens (10 sows/pen) within the same facility. Visual signs of estrus were observed to determine if in fact sows were in heat. Those signs included immobilization and presence of swelling of the vulva. Heat detection was conducted on Friday and Saturday morning and then again the following Monday thru Friday. Sows were checked in the presence of a mature boar and evaluated for previously mentioned signs of estrus. All sows remained in the group breeding pens until found in heat. All sows were then moved into the breeding barn and placed in gestation crates. Sows were then artificially inseminated with multiple sire semen which was collected on site at regular intervals to ensure viability of sperm cells. Sows received a second insemination 24 hours later. The same employee inseminated all sows. On Sunday of week three, sows were checked for heat due to an inadequate number of sows available for breeding. Dates that sows were bred were recorded for comparison of weaning to estrus interval. Sows that were not bred did not get included in the statistical analysis of wean to estrus interval.

On day 28 of possible gestation, sows which did not return to estrus, were ultrasounded for pregnancy. If ultrasound results were inconclusive, the ultrasound process was completed again the following week. After sows were checked pregnant,
they were moved into the gestation barn and placed in individual crates for the duration of pregnancy. Dates of all pregnancy checks were recorded for reference of farrowing date. One week before sows were due to farrow, they were moved to farrowing crates. The date farrowed, total number born and number born alive were recorded at farrowing.

Statistical analysis was performed using the mixed model procedure of SAS (9.1) with fixed effects of treatment, body condition score, breed composition and parity.

Note of Explanation Concerning Results

As the procedures note, the farm where the study was conducted did not normally check for estrus on Sundays. However, on Sunday of week three, farm personnel did check and observed eight sows in estrus, which led researchers to have concern about failing to detect estrus in those sows with shorter WEI. Therefore, the author will suggest implications that relate to these findings. The author recognizes that all sows should have been checked for estrus on Sundays and possibly Saturdays. The author further recognizes that researchers should have been included in estrus detection.
Chapter Four
Results and Discussion

Number of sows and reproductive responses are shown within Table 1. An increase in number of sows not detected when compared to controls may discourage the administration of exogenous gonadotropins. Furthermore, estimated number of pigs per treatment may be an attractive economic aspect to consider due to the control treatment group producing a more positive return on investment. Failure to detect estrus may be attributed to one or a combination of factors. Skill level and reproductive knowledge of the labor force, available labor dedicated to reproduction or sows exhibiting estrus earlier than expected (Graph 6) may all be possible causes.

| Treatment | # of Sows/ # of Sows | # of Sows | # of Sows | Total Total |
|-----------|-----------------------|-----------|-----------|-------------|-------------|
| P.G. 600  | 103                   | 73 (70.8) | 30        | 11.9        | 675.6       |
| PMSG      | 108                   | 82 (75.9) | 26        | 11.2        | 683.6       |
| Controls  | 108                   | 91 (84.2) | 17        | 11.0        | 761.6       |

a Least Squares Means (P>.05)

Data within Table 2 show sows which were ultrasounded at 21 days and determined to be pregnant or open (POS vs. NEG). Sows in the NEG column did not farrow. However, those sows in the POS column did farrow a subsequent litter at an appropriate date in relation to treatment. In this particular case 50 sows were called open and 20 of those farrowed. Of the sows deemed pregnant, 29 did not farrow. This may be due to environmental factors, disease or the sow being pregnant with less than four viable embryos (Dunne, 1958). Therefore, only farrowing data were considered for the evaluation of treatment.
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<table>
<thead>
<tr>
<th>Table 1. Reproductive Performance by Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>P.G. 600</td>
</tr>
<tr>
<td>PMSG</td>
</tr>
<tr>
<td>Controls</td>
</tr>
</tbody>
</table>

<sup>a</sup> Least Squares Means (P>.05)

Data within Table 2 show sows which were ultrasounded at 21 days and determined to be pregnant or open (POS vs. NEG). Sows in the NEG column did not farrow. However, those sows in the POS column did farrow a subsequent litter at an appropriate date in relation to treatment. In this particular case 50 sows were called open and 20 of those farrowed. Of the sows deemed pregnant, 29 did not farrow. This may be due to environmental factors, disease or the sow being pregnant with less than four viable embryos (Dunne, 1958). Therefore, only farrowing data were considered for the evaluation of treatment.
Table 2. Table of Pregnancy check by farrow record

<table>
<thead>
<tr>
<th>Pregcheck</th>
<th>Did not Farrow</th>
<th>Did Farrow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open (Neg)</td>
<td>30</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Pregnant (Pos)</td>
<td>29</td>
<td>167</td>
<td>196</td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>187</td>
<td>246</td>
</tr>
</tbody>
</table>

Neg = Negative (for respective category)
Pos = Positive (for respective category)

Least Squares Means for breed composition and parity production parameters are shown within the data of Table 3. In this particular operation, LY sows are preferred to DX sows for maternal lines. Due to expansion constraints within this herd, DX gilts were retained so that farrowing rooms could be filled each week. DX sows are still being rebred today with intent on one day being able to remove all terminal cross sows from production.

Furthermore, parity 3 sows had a lower mean estimate for wean to estrus interval than the parity 1 and parity 2 classified sows. Parity 3 sows are those who were believed to be parity seven or greater. These sows were most likely those who were better able to maintain condition throughout lactation, rebreed on first estrus and conceive consistently.

Table 3. Least Squares Means for Production Parameters

<table>
<thead>
<tr>
<th></th>
<th>Wean to Estrus Interval</th>
<th>Total Number Born</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY*</td>
<td>4.5</td>
<td>11.3</td>
</tr>
<tr>
<td>DX*</td>
<td>4.5</td>
<td>11.5</td>
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<tr>
<td>Parity 1*</td>
<td>4.7</td>
<td>11.6</td>
</tr>
<tr>
<td>Parity 2*</td>
<td>4.4</td>
<td>11.2</td>
</tr>
<tr>
<td>Parity 3*</td>
<td>4.4</td>
<td>11.4</td>
</tr>
</tbody>
</table>

LY= Landrace X Yorkshire crossbred
DX= Duroc X (LY) crossbred
*(P>.05)

Treatment effect upon WEI was highly significant (P<.0001) as summarized in Table 4 and Table 5. Least Squares Means for P.G 600, PMSG and Controls were 4.76 vs. 5.04 vs. 5.58, respectively. This suggest that the administration of exogenous
gonadotropins does induce estrus earlier, lowering the economic impact of nonproductive
days. These findings are in agreement with Hurtgen and Leman, (1979); Sechen et al.,
reported shorter intervals to estrus when exogenous gonadotropins were administered the
day of weaning or the day after weaning. To continue, a trend within the data implies that
P.G. 600 is more likely to encourage the onset of an earlier estrus than PMSG (P<.0670).
Due to the P.G. 600 treatment group having a Least Squares Mean value of 4.76 and a
standard deviation of .987 implies that 16% of a normally distributed population would
exhibit estrus at 3.8 days or earlier post weaning (Graph 6). At the current time, weaning
on this particular operation occurs on Wednesday. The sows that cycled early would
exhibit estrus on Saturday or Sunday and would most likely go undetected due to
insufficient labor.

No significant effects on WEI were found to be attributable to parity, breed
composition or BCS. However, within the study only one test subject was labeled with a
BCS of 1 which could provide evidence as to why these results conflict with MacLean,
(1968); MacLean, (1969); Reese et al., (1982a), which states that sows restricted in
energy or extremely thin experience increased WEI.
<table>
<thead>
<tr>
<th>Effect</th>
<th>Num DF</th>
<th>Den DF</th>
<th>F Value</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
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<td>232</td>
<td>16.31</td>
<td>&lt;.0001</td>
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<tr>
<td>Breed</td>
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<td>.05</td>
<td>.8210</td>
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<tr>
<td>BCS</td>
<td>8</td>
<td>232</td>
<td>.73</td>
<td>.6608</td>
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</tbody>
</table>

Trt = Treatment  
BCS = Body Condition Score
Table 5. Differences of Least Squares Means for Wean to Estrus Interval

<table>
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<th>Breed</th>
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<th>_breed</th>
<th>_Parity</th>
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<th>Standard error</th>
<th>DF</th>
<th>T value</th>
<th>Pr&gt;/T/</th>
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</thead>
<tbody>
<tr>
<td>Trt</td>
<td>M</td>
<td>P</td>
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<td></td>
<td></td>
<td></td>
<td>0.2811</td>
<td>0.1528</td>
<td>232</td>
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<tr>
<td>Trt</td>
<td>M</td>
<td>S</td>
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<td>Trt</td>
<td>P</td>
<td>S</td>
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<tr>
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<tr>
<td>Parity</td>
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<td>0.4206</td>
<td>232</td>
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<td>0.3504</td>
</tr>
<tr>
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<td>LY</td>
<td>DX</td>
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<td></td>
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<td>-0.04001</td>
<td>0.1766</td>
<td>232</td>
<td>-0.23</td>
<td>0.8210</td>
</tr>
</tbody>
</table>

Trt= Treatment
P= P.G.600
M= Pregnant Mare Serum Gonadotropin
S= Saline Placebo (Control)
LY= Landrace Yorkshire Crossbred
DX=Duroc Crossbred
Graph 6. Standard Deviation of Weaning to Estrus Interval by Treatment (Days)

Total number born among treatments were not significantly different (P>.05).

Results indicated that the administration of PMSG and P.G. 600 at the time of weaning did not significantly improve total number born in subsequent litters (Table 7 and Table 8). The current study conflicted with Sechen et al., (1990) who suggested that sows administered PMSG would have an increased subsequent litter size and born alive litter size. Deneke et al., (1973) and Huhn et al., (1989) expected an additional 2 extra piglets per litter when sows were treated with PMSG. The current study results are more in agreement with Hurtgen and Leman, (1979) and Kutz, (1997) who found no significant increase in subsequent litter size.

However, results from the current study approached significance (P<.1191) for the difference of .815 more pigs/litter when treated with P.G. 600 as compared to controls and this is in concurrence with Bates et al., (2000) who found a non-significant increase in total number born of .91 pigs/litter. Kirkwood et al., (1998) also reported a non significant(P>.05) .7 pig/litter increase in P.G. 600 treated sows when compared to controls. Tilton et al., (1995) also found that P.G.600 treated sows ovulated 7.1 more ova
than controls.

Neither parity, breed composition nor BCS exhibited a significant effect upon total number born (P>.05). These results concerning body condition score do not agree with King (1989) who stated that body composition does influence reproductive performance. Additionally, no differences exist in the data to encourage further exploration of parity, breed composition or BCS effects.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Num DF</th>
<th>Den DF</th>
<th>F Value</th>
<th>Pr &gt; F</th>
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<tbody>
<tr>
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<tr>
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<tr>
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<tr>
<td>BCS</td>
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<td>1.63</td>
<td>0.13</td>
</tr>
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</table>

Trt= Treatment
BCS= Body Condition Score
Table 8. Differences of Least Squares Means for Total Number of Pigs Born

<table>
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<tr>
<th>Effect</th>
<th>Trt</th>
<th>Breed</th>
<th>Parity</th>
<th>_Trt</th>
<th>_Breed</th>
<th>_Parity</th>
<th>Estimate</th>
<th>Standard error</th>
<th>DF</th>
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<th>Pr &gt;</th>
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<td>Breed</td>
<td>LY</td>
<td>DX</td>
<td></td>
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<td></td>
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<td>-0.2046</td>
<td>0.6295</td>
<td>179</td>
<td>-0.33</td>
<td>0.7455</td>
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Trt= Treatment
P= P.G.600
M= Pregnant Mare Serum Gonadotropin
S= Saline Placebo (Control)
LY= Landrace Yorkshire Crossbred
DX= Duroc Crossbred
The data in Table 9 show the percentage of sows that were not bred due to visual signs of estrus not being observed. It is believed that the effect of shorter WEI due to P.G. 600 and PMSG treatments confounded with the absence of Sunday heat checking practices as well as possible human error may account for the inflated percentage of treatment sows going undetected. Bates et al., (1991) suggested that P.G.600 treated sows do experience an earlier return to estrus which implies that sows within this study may have gone undetected. Further checking of production records support this theory as sows returned to estrus at an appropriate interval from when first estrus post weaning should have occurred. Additionally, data within Table 10 support previously mentioned literature as a higher percentage of sows labeled thin or extremely thin (BCS 2 or 1) were more likely to go undetected. As stated earlier, no significant effects upon total number born and WEI were attributed to BCS. However, these data do show that a higher percentage of sows who were assigned an extreme BCS (1.8 or 3.8) were less likely to exhibit estrus. These findings support Johnson et al., (2006) who stated that maintaining proper body condition (BCS 3) will lead to a more consistent reproductive performance resume. Achieving proper body condition has been a goal of this particular herd for some time. Extensive progress has been made, and this may be why BCS is limited to three scores of the five point scale. Nonetheless, results found within the data of Table 10 still express the effect of improper BCS.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Sows Not Bred</th>
<th>Sows in Treatment</th>
<th>% Sows Not Bred</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.G. 600</td>
<td>30</td>
<td>103</td>
<td>29</td>
</tr>
<tr>
<td>PMSG</td>
<td>26</td>
<td>108</td>
<td>24</td>
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<tr>
<td>Control</td>
<td>17</td>
<td>108</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 9. Percent of Sows Not Bred by Treatment
Table 10. Percent of Sows Not Bred by Body Condition Score

<table>
<thead>
<tr>
<th>BCS</th>
<th>Sows Not Bred</th>
<th># of Sows in BCS</th>
<th>% Sows Not Bred</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8 (2-)</td>
<td>6</td>
<td>13</td>
<td>46</td>
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<td>2</td>
<td>5</td>
<td>12</td>
<td>42</td>
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<tr>
<td>2.2 (2+)</td>
<td>8</td>
<td>38</td>
<td>21</td>
</tr>
<tr>
<td>2.8 (3-)</td>
<td>16</td>
<td>53</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>62</td>
<td>27</td>
</tr>
<tr>
<td>3.2 (3+)</td>
<td>15</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>3.8 (4-)</td>
<td>7</td>
<td>11</td>
<td>63</td>
</tr>
<tr>
<td>4</td>
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<td>0</td>
</tr>
<tr>
<td>4.2 (4+)</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

BCS = Body Condition Score
Chapter Five
Conclusion and Implications

Keeping in mind that the current study was conducted during the winter, it has little implication upon the administration of exogenous gonadotropins during the summer months. Data from this study may lead researchers to believe that it is not necessary to administer P.G. 600 or PMSG to weaned sows during cool season months. Control sows produced greater numbers of total pigs per treatment when compared to PMSG and P.G. 600 (761.6 vs. 683.6 vs. 675.6, respectively). This was due to a higher percentage of control sows being detected for estrus.

If treatment of weaned sows is desired, a logical recommendation for this particular operation is to wean pigs one day later or delegate adequate labor to check for estrus during the weekend. If in fact 16% of sows administered P.G. 600 exhibited estrus on day 3, a swine producer would observe a reduction in nonproductive days. Furthermore, breeding sows at an appropriate time in relation to time of estrus should be of concern. Breeding sows too early or too late may cause conception rate and farrowing rate to decline.

Utilizing P.G. 600 to increase total number born/litter may be advantageous as well. Approaching significance (P<.119), an increase of .815 pigs/litter should in turn help to increase total return on investment and justify the administration of P.G.600 to post-weaned sows.
Chapter Seven
Literature Cited


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Self, H.L. and R.H. Grummer. 1958. The rate and economy of pig gains and the reproductive behavior in sows when litters are weaned at 10 days, 21 days or 56 days of age. J. Anim. Sci. 17:862.


