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Introduction of Fertile Estrus in Prepuberal Gilts by Treatment with a Combination of Pregnant Mare's Serum Gonadotropin and Human Chorionic Gonadotropin

Technical Report No. 2

Abstract

Ten trials involving 678 presumed prepuberal gilts (5.5 to 7.5 months old) were conducted in North Carolina, Illinois and Missouri to evaluate the reproductive performance of gilts given a combination of 400 IU of Pregnant Marc's Serum Gonadotropin and 200 IU of Human Chorionic Gonadotropin (P.G. 600®). Gilts that were presumed to be prepuberal received P.G. 600® or no treatment (control) on the day of movement from finishing facilities to pens for breeding. Detection of estrus, with the aid of mature boars, was conducted daily for 28 days; gilts in estrus were mated naturally. Treatment with P.G. 600® increased the percentage in estrus within 7 (57.5 vs 40.9%) or 28 days (72.9 vs 59.5%); average interval to estrus was reduced (P(0.05 from 10.4 to 7.5 days). Farrowing rate (78.5 _+ 3.1%), number of pigs born alive (8.6 _+ 0.2) or dead (0.26 + 0.06) and number of pigs weaned (8.0 .f+ 0.2) were unaffected by treatment. Gilts that were heavier than the median for each farm were in heat sooner and more were detected in heat, but no other reproductive traits differed between heavy and light gilts. Overall, the results reveal that P.G. 600® was useful for induction of fertile estrus in prepuberal gilts. (Key Words: Gilts, Estrus, Puberty, Gonadotropins.)

Introduction

Efficiency of reproduction in swine herds would be enhanced if there were effective, approved methods for inducing estrus in gilts before their introduction into the breeding herd. Currently, more gilts are selected than are needed for replacements, and only gilts that show estrus during a specific period are mated. Gilts not mated eventually are sold at a lower price because they exceed the desired market weight. If estrus could be induced promptly and 3redlctably, producers could select fewer replacement gilts, fit these gilts into a specific schedule and sell the excess gilts at market weight.

Because Pregnant Mare's Serum Gonadotropin (PMSG) has biological properties similar to both FSH and LH, and HCG has many properties similar to LH, but with some FSH activity, it is physiologically appropriate to use these n combination to stimulate follicular growth in prepuberal gilts (Paterson, 1982; Webel and and Day, 1982; Foxcroft and Hunter, 1985; Dial and BeVier, 1986). Schilling and Cerne (1972) first reported the use of a low-dose PMSG-HCG combination for induction of estrus in gilts and anestrous sows, but the details of their. experiments were not described completely. Three of their five experiments were conducted on a single "industrial pig farm" of 2,500 sows in Yugoslavia, and the two other experiments were conducted at undisclosed locations. In their studies, control gilts were observed for estrus over an unspecified period of time, and they did not report intervals to first heat of control or treated gilts after movement to breeding barns and exposure to boars. They provided no description of how the treated or control gilts were handled in terms of movement to pens for breeding and exposure to boars.

The trials described herein were conducted to evaluate the effectiveness of P.G. 600®, a combination of 400 I.U. of PMSG and 200 I.U. of HCG, for induction of estrus in gilts on commercial farms in the U.S.

Material and Methods

Ten trials were conducted from the fall of 1984 until the fall of 1985 and utilized 678 gilts in four swine units in eastern North Carolina, three units in central Illinois and three units in central Missouri. These units were all intensely managed and most or all of the animals on each farm were housed in total confinement. The herds ranged in size from 150 to 1,000 sows. Cooperating swine producers were selected for the study on the basis of their willingness to adhere to an experimenlal protocol approved by the U.S. Food and Drug Administration (FDA).

On each farm, market-weight crossbred gilts (5.5 to 7.5 months of age and 86 to 163 kg BW), presumed to be prepuberal, were moved from finishing facilities to pens for breeding and were assigned randomly to two groups of equal numbers. One group of gilts received P.G. 600® and the other group served as controls. Immediately prior to use, the lyophilized P.G. 600® was diluted with a sterile diluent provided by the manufacturer. The solution was injected (i.m.) through a 3.8 cm, 20-gauge disposable hypodermic needle in the neck immediately behind an ear. Gilts assigned to the control group were not injected. Injections were given on the day (day 0) that gilts were moved from finishing buildings to breeding units. At 9 of 10 units, the pens used for breeding had concrete floors and were in environmentally controlled or open-front buildings. At the remaining unit, gilts were bred in pasture lots. The number of gilts treated with P.G. 600® ranged from 20 to 96 among the 10 farms.

Gilts were checked for estrus with mature boars at least once daily for 28 days after treatment. Gilts in estrus were mated naturally once daily during estrus. Boars were used randomly across treatments, and at some units gilts were mated to different boars on consecutive days of estrus. Dates of treatment, estrus, mating, return to estrus, farrowing and weaning were recorded for each gilt. Service boar, number and survival of pigs farrowed, litter weaning weights and rebreeding performance after weaning the first litter were recorded. On the day of treatment, gilts were weighed individually, or their weights were estimated by measuring the heart girth and converting the measurements to kilograms by equations derived from unadjusted data of Esbenshade et al. (1986). At farrowing, litter sizes were adjusted by cross-fostering piglets within treatment groups (control or P.G. 600®) for gilts that farrowed together.

Data from gilts that were detected in estrus within 28 days after treatment were included in all analyses. Data from gilts not detected or those detected later than 28 days (after trials were completed) were used only for analyses of precentage in estrus. Binomial response traits (estrus, rebred, farrrowed, etc.) were analyzed by assigning each gilt a 1 (i.e., in estrus) or 0 (i.e., not in estrus) for each trait in question. Data were analyzed by least squares analyses of variance using the General Linear Models procedure (SAS, 1985). The randomized complete block model included treatment, farm and the treatment x farm interaction as sources of variation. The effect of treatment was tested by using the treatment x farm mean square. Gilts were classified as light or heavy if they were below or above the median weight for the farm. Effect of weight on traits was analyzed with a statistical model that included weight class, treatment and their interaction. Chi square procedures were used for analyses of data on distribution of estrus after treatment.

Table 1. Least Squares Means of Reproductive Traits for Gilts Treated with P.G. 600

	Treatment				
	Control		P.G. 600		
Trait	No.	Mean	No.	Mean	SE[a]
Percentage in estrus within 28 days after treatment	341	59.5	337	72.9[b]	2.7
Days from treatament to estrus	201	10.4	253	7.5[b]	.4
Percentage rebred[c]	165	12.7	208	16.4	2.9
Farrowing rate, %[d]	190	78.9	236	78.1	3.1
Pigs born alive per litter	149	8.6	182	8.6	.2
Pigs born dead per litter	149	.27	181	.24	.06
Pigs weaned per litter	146	8.1	178	7.8	.2
Days to estrus after weaning	45	20.6	49	9.6	3.2
Percentage in estrus after weaning	55	77.0	67	82.5	5.3

[a]Approximate pooled standard error estimated from standard errors from each treatment group.
[b]P.G. 600 groupdiffers from control group (P < .05).
[c]Percentage rebred is the percentage that returned to heat after the original mating.
[d]Farrowing rate is the percentage of gilts that farrowed to the first mating.

Figure 1.

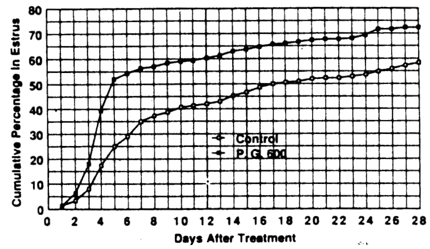
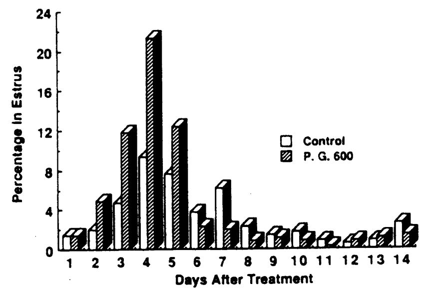


Figure 2.



Results

Treatment of gilts with P.G. 600® increased Ihe percentage of gilts in estrus within 28 days (Table 1, Figure 1), This response was consistent across farms. For example, the percentage of P.G. 600®-treated gilts in estrus within 28 days exceeded Ihat of the controls on seven farms, was equal to that of controls on two farms and was less than that of controls on one farm, Among farms, percentage of P.G. 600®-treated gilts in estrus within 28 days ranged from 42 to 97%, compared with 31 to 90% of controls.

Interval from treatment to onset of estrus was less for gilts treated with P.G. 600® (Table 1), and the consistency of response was such that P.G. 600®-treated gilts had shorter intervals to estrus on seven farms, had intervals similar to controls on one farm and had intervals longer than controls :on two farms. Among the 10 farms, interval from treatment to estrus ranged from 3.9 to 12.1 days for gilts treated with P.G. 600®, compared with 4.6 to 17.5 for controls.

The distribution of periods of estrus for gilts detected within 14 days after treatment is illustrated in Figure 2. More P.G. 600®-treated gilts showed estrus within 7 days than controls (P(0.05). Occurrence of estrus peaked on day 4 in both groups (Figure 2). For the 3-day period centered on day 4, 45.5% of gilts treated with P.G. 600® were detected in heat, compared with 21.6% for controls. There were no differences in percentages detected between 8 and 28 days. The degree of estrus synchronization was estimated by calculating the withintreatment variance for days to estrus. The variance was 50.7 days for controls, compared with 39.0 days for gilts treated with P.G. 600®0 (P<0.05).

The percentage of gilts that returned to estrus after the first breeding (rebred, Table 1) did not differ between groups and averaged 12.8% for controls, compared with 16.4% for those injected with P.G. 600®. Farrowing rate did not differ between the two groups. Among nine farms with complete farrowing data, farrowing rate was similar between groups on six farms, it was greater for the controls on two farms, and it was greater for gilts given P.G. 600® on one farm. Farrowing rates ranged from 55 to 97% for gilts treated with P.G. 600®, compared with 50 to 100% for controls.

Litter traits were not different between the treatment groups. Among farms, number born alive ranged from 7.1 to 9.5 for gilts given P.G. 600®, compared with 7.3 to 8.9 for controls. On one farm, number of live pigs from gilts treated with P.G. 600® exceeded that of controls by 2.2 pigs per litter, whereas on another farm this difference was 1.3 pigs per litter, On three farms, the number of live pigs per litter from control gilts exceeded that of P.G. 600®-treated gilts by 1.0 to 1.5 pigs. The number of pigs weaned per litter did not differ. Cross-fostering of pigs was performed within treatment groups so that we could determine whether treatment affected number weaned. On two farms, the number weaned by control gilts exceeded that of gilts given P.G. 600® by 1.3 to 1.6 pigs per litter, but on two farms, gilts given P.G. 600® weaned 0.6 to 0.7 more pigs per litter than controls. Litter weights were recorded at 21 days of lactation on one farm. Litters from gilts given P.G. 600® averaged 37.8 kg, compared with 36.1 kg for controls (P) 0.05).

Number of days from weaning the first litter to onset of estrus was recorded on three farms. Gilts treated with P.G. 600® returned to estrus in 9.6 days after weaning, compared with 20.6 days for controls. Gilts were not retreated with P.G. 600®. This difference was not significant (P<0.14).

Actual or estimated weights of gilts at treatment ranged from 86 to 163 kg. The effects of weight class on responses are illustrated in Table 2. More heavy gilts were detected in estrus (77.7 vs. 62.3%), and they tended to show estrus sooner after treatment (7.6 vs. 9.2 days). None of the other reproductive traits differed between the weight classes, and there were no significant treatment x weight class interactions.

Table 2. Least Squares Means of Responses to P.G. 600 by Gilts of different weight classes

Trait	Control		P.G. 600		Significance[b]		
	Light[a]	Heavy	Light	Heavy	T	W	T▪W
Percentage in estrus within 28 days after treatment	54.4	71.1	70.2	84.2	<.01	<.01	NS
Days from treatament to estrus	10.9	8.8	7.6	6.3	<.05	<.14	NS

[a]Gilts were classified as light or heavy if they were below or above the median for the farm, respectively.
[b]T = treatment, W = weight group, T▪W = treatment x weight group interaction, NS = not significant.

Discussion

In these trials, market-weight gilts were moved from finishing facilities to pens for breeding and given daily contact with boars. Control gilts that were detected in heat within 4 weeks were in estrus 10.4 days after movement and boar exposure. This is approximately 4 days earlier than the average for 13 trials involving gilts of similar age (see Table 6.9 in Hughes, 1982). Gilts treated with P.G. 600® were in estrus 3 days earlier than controls, and a higher percentage of them were detected in estrus during the first week after treatment. Because estrous females apparently stimulate expression of sexual behavior in their penmates (Hemsworth, 1982), it is possible that the P.G. 600®-treated gilts enhanced the estrus response of the controls during the first week. Control gilts were not injected, so we cannot rule out the possibility that an acute stressor such as an injection would have increased the proportion of gilts in heat within 4 weeks. However, control gilts were moved to different facilities and given exposure to boars, both of which should be more stressful than an injection.

Treatment with P.G. 600® did not alter any reproductive traits other than percentage of gilts in estrus and interval to estrus. Farrowing rate, litter size, number of pigs weaned and rebreeding performance after weaning the first litter were not di~ ferent between treatment groups. Undesirable effects such as poor expression of estrus and low fertility often have been encountered with higher doses of gonadotropins (Paterson, 1982). The relatively low doses of PMSG and HCG in P.G. 600® apparently act synergistically to give a response that is greater than that observed when a similar dose of PMSG is given alone (Britt et al., 1986). A greater percentage of heavy gilts were detected in estrus, and these gilts were bred sooner after treatment than light gilts. Although the interaction was not significant, there was a tendency for P.G. 600® to provide more stimulation for light gilts than for heavy ones. For example, there was a 24% difference in favor of P.G. 600®-treated gilts for the proportion of light gilts detected in heat, compared with a 14% difference for the heavy group. Similarly, P.G. 600® induced estrus an average of 3.3 days earlier in the light gilts, compared with a 2.5 day advantage for the heavy class. Otherwise, light gilts produced just as well as heavy ones, delivering and weaning the same number of pigs and rebreeding at the same rate after weaning the first litter.

The usefulness of P.G. 600® to the swine producer can be illustrated by examining the cumulative estrus response curves in Figure 1. With P.G. 600®, 57.5% of the assigned gilts were detected in estrus within the first week after treatment, but 21 days were needed to detect a similar percentage (58.1%) of controls. The 50th percentile was reached in 5 days in the P.G. 600® group, compared with 18 days in controls. Thus, it took about three times as long to breed the same proportion of gilts in the control group as in the group given the gonadotropins. The greatest difference between the two groups occurred during the first 5 days, where the slopes of the two curves differed most. Beyond the first week, the response curves increased at similar rates, indicating that the P.G. 600® exerted no long-term effects and that gilts that failed to respond initially continued to respond as if they had not been treated (e.g., at the same rate as the controls).

There was no indication that gilts ovulated in response to P.G. 600® without expressing estrus. Evidence for missed heats would be a secondary rise in the estrus response about 3 weeks after the initial anticipated estrus. Seventeen gilts treated with P.G. 600® and 26 controls were detected in heat during the 4th week following treatment; thus, there was no indication that more P.G. 600®-treated gilts were in heat than expected. We did not collect blood samples for measurement of progesterone in anestrous gilts, so we have no measure of the percentage of gilts that were already exhibiting estrus cycles and therefore would not have been responsive to P.G. 600® (Paterson, 1982).

In summary, P.G. 600® was effective for increasing the proportion of gilts in estrus within the first week after movement of market-weight gilts to pens for breeding. Moreover, the synchrony of heat was more precise in these P.G. 600®-treated gilts. Having more gilts exhibit heat at predictable times permits more efficient scheduling of breeding and farrowing facilities and provides greater opportunities for introduction of gilts into sow groups when sows are rebred after weaning. Because litter sizes can be lower for gilts bred at first heat rather than at second or third heat, P.G. 600® could be used to synchronize a group of gilts for subsequent breeding at the second or third heat after treatment.

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