EFFECT OF FUSARIUM ROSEUM (GIBBERELLA ZEA) ON PREGNANCY AND THE ESTROUS CYCLE IN GILTS FED MOLDED CORN ON DAYS 7-17 POST-ESTRUS


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ABSTRACT


A laboratory produced corn culture of Fusarium roseum (Gibberella zea) was fed as 10% of the total diet to bred and non-bred gilts on days 7-17 post-estrus. The corn culture contained both zearalenone and deoxynivalenol by analysis, and caused considerable feed refusal.

Although 6 of 10 bred gilts fed the corn culture appeared to be pregnant by ultrasound testing between days 40-50 post-breeding, none of them farrowed. Progesterone analyses indicated that none of the 10 gilts cycled normally during the 20 week observation period. Three maintained high serum progesterone (>10 ng/ml) during the entire period. Progesterone analyses were similar in 5 non-bred gilts fed the corn culture in that none of them cycled normally in 20 weeks.

The retention or loss of corpora lutea could not be attributed to levels of luteinizing hormone, as no relationship was found between concentrations of progesterone and luteinizing hormone.

This experiment indicates that limited dietary exposure of female swine to Fusarium roseum infected corn can result in embryonic loss and disruption of normal reproductive cycling for an extended length of time.

INTRODUCTION

Fusarium roseum (Gibberella zea) molded feed in the diet of pregnant gilts and sows has been associated with abortions, stillbirths, decreased litter size, birth of weak pigs, and fetal mummification (Hiller et al., 1973; Sharma et al., 1974; Christensen, 1979). Most of the adverse effects of F. roseum molded feed on reproductive functions in swine have been attributed to the estrogenic mycotoxin, zearalenone (Christensen, 1979). Ingestion of 100 ppm of purified zearalenone by sows from breeding to expected gestation caused...
pseudopregnancy characterized by retention of corpora lutea. Lower dietary concentrations of zearalenone (25 and 50ppm) resulted in smaller litters and smaller pigs at birth (Chang et al., 1979). Very low dietary concentrations of zearalenone apparently have no effect on pregnancy as evidenced by feeding pregnant sows diets containing 2.2ppm or 3.6ppm zearalenone by analysis (Etienne et al., 1979; Shreeve et al., 1978).

In previous studies, *F. roseum* molded grain or zearalenone was fed to bred sows for long periods. The purpose of the present study was to define a period of susceptibility of pregnant pigs to ingestion of *F. roseum*. The nature and duration of hormonal changes were characterized by determination of serum progesterone and luteinizing hormone.

**MATERIALS AND METHODS**

*P. roseum* 'graminearum' (Gibberella zeae) Purdue #1693 was grown on sterile popcorn as previously described (Long et al., 1982). The corn culture was dried, ground, and mixed with a standard 14% protein corn-soybean swine gestation ration. The *F. roseum* corn culture was added as 10% of the total diet. Samples of the mixed ration were analysed for concentrations of zearalenone and deoxynivalenol. Zearalenone was assayed by thin layer chromatography (Official Methods of Analysis, AOAC, 1980). Deoxynivalenol was assayed by gas chromatography-mass spectrometry (Vesonder et al., 1978, and 1980/81).

As mature crossbred gilts (108-137kg) exhibited estrus, they were assigned to one of the following groups:

- **Group 1** (10 gilts, designated A-J): Gilts were bred by natural service by two different boars within a 24 hour period. Gilts were fed the *F. roseum* diet from days 7-17 post estrus (PE).
- **Group 2** (5 gilts, K-O): Gilts were observed to be in estrus, but were not bred. Gilts were fed the *F. roseum* ration days 7-17 PE.
- **Group 3** (4 gilts, P-S): Gilts were bred and fed the standard (control) ration.

Blood samples were drawn from the precava at weekly intervals during weeks 1-5 PE from all gilts and at 2 week intervals during weeks 7-20 PE from gilts in groups 1 and 2. Serum concentrations of progesterone and luteinizing hormone (LH) were assayed by radioimmunoassay (Niswender et al., 1969; Niswender 1973). The first and last serum samples from each gilt were tested for antibodies to porcine parvovirus by an indirect fluorescent antibody technique (Animal Disease Diagnostic Laboratory, Purdue University).

Gilts were examined visually for signs of estrus during the first 5 weeks PE. Each gilt was tested twice for pregnancy by 3 people on different days between 40 and 50 days PE with an ultrasonic pregnancy testing device (Scanoprobe, Ithaco Company, Ithaca, New York, USA).
RESULTS

The measured concentrations of zearalenone and deoxynivalenol in the F. roseum mixed feed were 107ppm and 8ppm, respectively. Varying degrees of feed refusal were exhibited by gilts given the F. roseum feed. Estimates of consumption of the F. roseum feed were 0.5-1.0 kg per gilt per day.

Five of the gilts in treatment group 1 had swelling of the vulva and/or demonstrated lordosis for variable periods during the time they were consuming the F. roseum diet. Two gilts in group 2 (M and O) exhibited estrus between 19 and 22 days PE and one gilt in group 3 exhibited estrus 17 days PE. Pregnancy testing of the group 1 gilts resulted in 6 being called pregnant, one non-pregnant, and 3 questionable. Of the gilts in group 2, 2 appeared to be non-pregnant and the other 3 were questionable. Three gilts in group 3 tested as pregnant, and one (Q) as non-pregnant.

Three trends were evident in the serum concentrations of progesterone in the group 1 gilts. In 3 gilts (Fig. 1), corpora lutea were maintained throughout the 20 week period, as indicated by high concentrations of serum progesterone (>10 ng/ml). Serum concentrations of progesterone fell to <1 ng/ml in 4 gilts from weeks 4-14 PE (Fig. 2). In these gilts, the serum progesterone concentration remained low for the remainder of the test period, indicating an absence of corpora lutea. The pattern of concentrations of serum progesterone in gilt B indicated that she failed to develop corpora lutea on the first cycle, and returned to estrus during week 3-4. When the corpora lutea from this cycle regressed, she did not recycle. The remaining group 1 gilts started out with high concentrations of serum progesterone (>20 ng/ml) which fell and rose at various times from 10-20 weeks PE (Fig. 3).

Serum progesterone concentrations of the group 2 gilts showed the same inconsistencies as group 1 (Fig. 4). In the 3 pregnant gilts in group 3, the serum progesterone concentrations from breeding through week 5 PE were similar to those of the group 1 gilts depicted in Fig. 1. The non-pregnant control gilt (Q) demonstrated decreases in serum progesterone concentration coincident with behavioral estrus.

Luteinizing hormone was present in the serum of pigs in all treatment groups and no difference in concentrations among groups was found. There was no apparent relationship between concentrations of LH and progesterone.

None of the bred gilts fed the F. roseum culture farrowed. The control gilts had a farrowing rate of 75%; gilt Q did not farrow. The farrowing rate on the farm for the same breeding period was 77%.

A significant increase in serologic titer to porcine parvovirus was demonstrated in only two gilts. Other gilts had a decrease or no change in titer.
Fig. 1. Serum progesterone in bred gilts fed *F. roseum* molded feed. Progesterone concentrations remained high during the entire trial. (Letters indicate individual gilts).

Fig. 2. Serum progesterone in bred gilts fed *F. roseum* molded feed. Progesterone concentrations fell during the trial.

Fig. 3. Serum progesterone in bred gilts fed *F. roseum* molded feed.

Fig. 4. Serum progesterone in non-bred gilts fed *F. roseum* molded feed.
DISCUSSION

The results of the present experiment are in agreement with previous reports associating the consumption of F. roseum molded feed or zearalenone with loss of pregnancy in swine (Miller et al., 1973; Christensen, 1979; Sharma et al., 1974; Kurtz et al., 1969). We chose a limited feeding time in contrast to many of the previous reports in which the feeding of molded corn or zearalenone was conducted throughout gestation. The time of implantation was targeted because the initiation of implantation in the pig appears to be critical for maintenance of the corpora lutea and pregnancy (Dhindsa et al., 1968).

Exposure of sows to excessive estrogen at this time will result in maintenance of the corpora lutea (Gardner et al., 1963).

Studies by us with varying concentrations of F. roseum molded corn in the diet (Long et al., 1982) and by others with varying concentrations of zearalenone (Chang et al., 1979) have shown the corpora lutea to be maintained. The morphologic appearance of the uterus and fallopian tubes appeared to be primarily what would be expected with progesterone stimulation, but it was altered by varying degrees of estrogenic changes depending upon the concentration of zearalenone in the diet. Two changes in the serum progesterone concentrations in this experiment may have relevance to exposure of sows to F. roseum in field situations. First, the changes in the serum progesterone levels occurred whether the pigs had been bred or not bred before treatment. Secondly, although the serum progesterone concentrations of different gilts fell at different times during the experiment, none of them could be said to cycle normally during the 20 weeks of observation.

It is possible that the detrimental effect of F. roseum on pregnancy is not due solely to zearalenone. Other fungal metabolites may also play a role. The molded corn used in this study contained a considerable amount of the trichothecene mycotoxin deoxynivalenol. Deoxynivalenol is reported to occur commonly in Fusarium molded corn (Mirocha, 1979) and is the mycotoxin usually associated with feed refusal by swine (Kotsonis et al., 1975).

Although the effect of deoxynivalenol on pregnancy has not been established, other trichothecene mycotoxins have been shown to be embryotoxic and teratogenic in rodents (Hood et al., 1979; Stanford et al., 1976). T-2 toxin (produced by F. tricinctum) has been demonstrated to cause infertility in sows if added to the feed (Weaver et al., 1978a and 1978b).

In this experiment, commonly employed techniques of pregnancy diagnosis in the pig as well as progesterone analyses did not reliably identify treated animals as being non-pregnant.
REFERENCES


