Fertility of the Turkey Hen as Affected by Initial Insemination and Onset of Egg Production[1]

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ABSTRACT A comparison between initial inseminations of Large White turkey hens prior to or after onset of egg production was undertaken to determine the effect on fertility. Semen from Bronze toms was utilized for the initial inseminations whereas all subsequent inseminations utilized White sires.

After 10 weeks there were no significant differences between treatments for percent egg production or hatchability. Inseminating prior to the onset of egg production resulted in a significantly different ($P \leq .05$) 8-week average of 97.5% fertility in the early insemination (EI) group as compared to an average of 90.4% in the late insemination (LI) group. Differences between the EI and the LI groups were greatest during the last 2 weeks of the experiment during which the EI hens maintained higher levels of fertility. Bronze poults were observed in the EI progeny following three subsequent inseminations with semen from White sires, whereas no Bronze poults were obtained from the LI hens following the third subsequent insemination with White semen.
(Key words: fertility, turkey, initial insemination)

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INTRODUCTION

Among naturally mating turkeys the female initiates the mating process. This behavioral pattern was observed by Margolf *et al.* (1947) and later by Carte and Leighton (1969). They reported that the mating frequency of turkey hens was highest before laying commenced. In fact, according to Margolf *et al.* (1947) the peak of mating frequency preceded maximum egg production by 4 weeks and then declined almost to the minimum by the time maximum egg production was attained.

Verma and Cherms (1965) reported that 5 days were required for sperm cell concentrations to peak in the uterovaginal (UV) sperm host glands of turkeys following insemination. No data, however, were presented for the interval between 90 min and 5 days after artificial insemination (AI). Conversely, Compton and Van Krey (1979a) showed that in the chicken the percentage of glands containing sperm 24 hr after an artificial insemination was not significantly different from the percentage 6 days post-AI in the absence of an ovulation or oviposition.

While data on sperm concentration in the UV host glands of laying hens seems inconclusive, the authors wished to investigate filling of the sperm host glands before and after the onset of egg production. Specifically, is fertility enhanced by taking advantage of the hen's natural desire to mate?

The objective of this experiment was to observe the effects of artificially inseminating prior to or after initial oviposition on fertility in the turkey hen.

MATERIALS AND METHODS

Sixty Broad Breasted White turkey hens were randomly assigned to two treatment groups at 30 weeks of age. Each treatment consisted of two replicates of 15 birds each. Broad Breasted White and Broad Breasted Bronze toms were housed in pens separate from the hens in a commercial-type wooden pole house. Pens measuring 2.4 m × 5.5 m were used with 10 cm of wood shavings on the floor.

Commercially accepted practices were followed for nest, feeder, and floor space. A 17% crude protein turkey hen breeder ration was fed

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ad libitum providing 1320 kcal/kg metabolizable energy and 2.67% Ca.

At 30 weeks of age, September hatched virgin hens were transferred from a light-proof house to a commercial-type wooden pole house, and daylength was increased from 6 hr (6L:18D) to 16 hr (16L:8D). Artificial lighting was provided both morning and evening with a light intensity of not less than .092 lx at bird level. Hens assigned to Treatment 1 were inseminated initially at 11 and 14 days following photostimulation. This treatment was designated as the early insemination (EI). The hens of Treatment 2 were inseminated initially at 23 and 26 days following photostimulation, i.e., after surpassing 5% egg production. This treatment was designated as the late insemination (LI).

Semen from Bronze toms was utilized for the initial inseminations of both treatment groups, whereas subsequent inseminations (at 14 day intervals) utilized semen from White toms. By using semen from Bronze toms initially, the extended appearance of Bronze poults should indicate greater numbers of spermatozoa stored initially in the UV glands.

Semen was collected from males into an open vial and diluted 1:1 with a commercially prepared Minnesota semen diluent. Hens were inseminated in the afternoon with .025 ml of the diluted semen using individual plastic straws. All inseminations were with approximately 9×10^7 spermatozoa as measured by spermatocrit.

The first egg was laid 14 days following photostimulation beginning day 1 of the egg production period. Eggs were collected twice daily and stored in a cooler at 15 C. All settable eggs were incubated and hatched in a commercial hatchery (elevation 1421.3 m) without supplemental oxygen. Eggs were set weekly and candled for fertility on the 14th day of incubation. All eggs candling clear were removed and broken out to determine true fertility according to the guidelines set forth by Brown (1964). The remaining eggs were transferred to the hatcher on the 25th day of incubation. After transfer, eggs were trayed separately according to pen and treatment to determine the percent Bronze poults for each individual pen. All eggs failing to hatch were also broken out to determine time of death. Poult color was determined for embryos developing beyond the 3rd week of incubation.

Data were collected during the first 10 weeks of egg production. Percent hen-day egg production, percent fertility, and percent hatch of fertile eggs were all recorded by day over the entire study. Poult color following a change of sires was recorded on a weekly basis.

Data from this experiment were analyzed for statistical significance using an analysis of variance on weekly averages. Percent fertility, percent hatch of fertile eggs, and percent Bronze pullets were calculated by week following the initial insemination, where day 1 was designated as the day of the second initial insemination. Weekly averages for percent Bronze poults were not analyzed statistically, because significance depended on how time intervals were chosen with regard to subsequent inseminations. These data, however, were a binomial distribution and the number of poults used to determine each value are shown in Table 2.

RESULTS

Inseminating virgin hens initially prior to (EI) or after (LI) the onset of egg production had no significant effect on percent egg production ($P \leq .05$). A flock average of 28 eggs per hen was obtained through the 10 weeks of production.

A significant difference ($P \leq .05$) was observed, however, between the EI and LI groups for percent fertility (Table 1). The overall results of the experiment show an average of 97.5% fertility in the EI hens as compared to an average of 90.4% for the LI hens. Analysis of the data revealed that differences between the EI and LI hens were greatest during weeks 7 and 8 post-initial AI. The EI hens maintained significantly higher levels of fertility during this period. By 7 weeks, the percent fertility in the LI hens had decreased to below 98%, whereas the percent fertility in the EI hens remained above 97% on the same 14-day insemination intervals. Results also showed a peak fertility of 99% in Treatment 1 as compared to 94.6% in Treatment 2.

Hatchability, recorded as the percent hatch of fertile eggs, showed no substantial differences for the experimental period between the EI and LI groups. Treatment means of 41.8% and 38.3% hatch of fertile eggs were obtained for the EI and LI hens, respectively, at high altitude with no supplemental oxygen.

The percentage of Bronze poults observed each week are reported in Table 2. The data are presented by weeks following the initial

TABLE 1. *Percent fertility and number of settable eggs by week following initial insemination*

Treatment[1]	Week 1	2	3	4	5	6	7	8	Pooled treatment average[2]
Early insemination (EI)	80.0[a] (10)[3]	96.6[a] (65)	99.0[a] (106)	96.5[a] (108)	98.5[a] (79)	96.9[a] (103)	97.5[a] (85)	98.8[a] (78)	97.5[a]
Late insemination (LI)	88.0[a] (127)	92.2[a] (116)	91.0[a] (90)	94.6[a] (98)	93.3[a] (73)	88.5[a] (77)	86.3[b] (73)	86.9[b] (69)	90.4[b]

[a,b]Values in columns with different superscripts differ significantly ($P \leq .05$).

[1] EI hens were inseminated at 11 and 14 days post lighting and then biweekly; LI hens were inseminated at 23 and 26 days post lighting and then biweekly.

[2] Based on total settable eggs over 8-week period.

[3] Number of settable eggs.

inseminations in order to compare the persistence of Bronze poults. The length of time that Bronze poults appeared in the progeny following the initial inseminations was greater in the EI hens. Bronze poults were obtained from the EI hens after three subsequent biweekly inseminations with semen from White toms, whereas no Bronze poults were obtained from the LI hens following the third insemination with semen from White toms.

DISCUSSION

A difference in percent fertility was observed between the EI and LI treatments (Table 1). Artificially inseminating turkey hens before laying commenced resulted in a 7% increase in fertility over the 8-week period. Also, the EI hens maintained a higher level of fertility for a longer period of time. These hens exhibited greater than an 11% difference in fertility by 7 weeks. This difference in fertility may be related to the physiologic receptiveness of the oviduct at the time of insemination as indicated by the hen's desire to mate. Christensen (1981) commented that the physiologic state of the turkey oviduct early in the reproductive cycle, as opposed to late in the cycle, may contribute to the retention of spermatozoa. Van Krey *et al.* (1967) observed a decreased sperm retaining ability of the turkey oviduct as the cycle progressed, especially in low fertility hens. Therefore, a peak in mating frequency prior to the onset of egg production may indicate a time of optimal receptiveness of the oviduct to spermatozoa. If this is true, greater numbers of spermatozoa would be expected to be stored and/or maintained initially.

To investigate this possibility, semen from Bronze toms was used for the initial inseminations in both groups to provide phenotypic markers in the progeny resulting from those inseminations. Bronze poults were observed in the EI hens following three subsequent inseminations with White semen, while no Bronze poults were obtained from the LI hens after three inseminations with semen from White toms. The extended appearance of Bronze poults in the EI treatment may indicate an increased receptiveness of the hen's oviduct to spermatozoa during the time that natural mating frequency is highest. Furthermore, inseminating prior to the onset of egg production may allow the sperm host glands to fill nearer optimum concentrations. Recent data

TABLE 2. *Percent Bronze poults by week following initial insemination*

Treatment	Week							
	BB[2] 1	W 2	3	W 4	5	W 6	7	8
1	100.0 (4)[1]	100.0 (47)	70.2 (84)	48.7 (76)	20.4 (54)	9.3 (75)	1.92 (52)	2.4 (41)
2	100.0 (84)	100.0 (84)	70.7 (58)	45.3 (75)	23.4 (47)	9.4 (32)	0.0 (24)	0.0 (19)

[1] Number of poults obtained.

[2] B and W indicate times and phenotype of insemination (B, Bronze; W, White).

have shown that more frequent inseminations or increased sperm numbers above a critical level do not increase the rate of sperm storage gland filling in laying hens (Compton and Van Krey, 1979b; Christensen, 1981). Compton and Van Krey (1979b) hypothesized that only a certain number of spermatozoa are capable of being trapped and/or stored by the glands during a specific time interval. They also suggested that sperm cells in excess of this number were either lost from the oviduct, trapped within the albumen of a developing egg, trapped in the oviductal crypts, or entered infundibular storage sites. Christensen and Johnston (1977) have also shown that calcification of an egg in the oviduct could be an impairment to fertility. Collectively, these reports and the results of the present study suggest that increasing the time interval between AI and oviposition could have provided greater opportunity for spermatozoa to enter the storage glands initially, resulting in a persistence of Bronze poults in the EI hens.

The increased fertility in the EI hens, combined with the persistence of Bronze poults from the initial early inseminations, seems to support the concept of enhanced oviduct receptiveness to spermatozoa prior to the onset of egg production. Whereas evidence indicates that it is beneficial to take advantage of this receptiveness, the possible saturation of the sperm host glands with greater numbers of spermatozoa initially is still uncertain. Histological examinations as well as examinations of strain and seasonal effects should lead to a better understanding of this subject.

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