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Research paper

Effects of laying period modulation on the reproductive performance of breeding geese reared in a water pad windowless building

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ABSTRACT

The objectives of this study were applying environmental control technologies for comparing the reproductive capacity, the reproductive period and the adjusted period of the breading geese among three production types. A total of 7136 White Roman geese (5947 female geese and 1189 male geese) at 68 weeks of age were randomly divided into period adjustment with a water pad windowless building set (set A), natal period adjustment with traditional open building set (set B) and natural period with traditional open building set (set C).

The experimental results indicated that the laying period of the set A, set B and set C are 177, 94 and 147 days respectively. The average laying rate, hatchability and fertilization rate of set A were the highest, but there were not significantly different among three sets ($p > 0.05$). The average egg production number per female goose for set A was 55 eggs which was the highest. The average product gosling number per female goose of the set A was 41 birds which was more than that of set B (19 birds) and that of set C (26 birds).

Therefore, the laying period of goose could be successful adjusted to the non-breeding season and extended it with the water pad environment of control building for reducing summer temperature and short light time.

1. Introduction

Geese still retain the habits of migration birds, and possess the seasonal breeding behavior under the natural sunlight conditions (Rosiñski et al., 1996; Zeman et al., 1990) which results in the lower reproductive performance than that of Beijing ducks or Muscovy ducks (Pingel, 1990). Generally speaking, the goose egg laying period above average level was 135 days, the egg laying rate was 30%, the egg production number was 40, the breeding egg fertilization rate was 80%, the breeding egg hatchability was 80%, and the number of descendants was 25 in Taiwan (Yeh, 1999). Taiwan is located in the subtropical zone, and the goose breeding season is from October to the next May. The price of goslings hatched in non-breeding season was 3–5 times higher than that of the breeding season (Wang et al., 1998). In order to increase revenue, some of the industry owners utilized restricted feeding means and force molting to change the breeding period of the geese. The laying rate was 50–70% of the normal laying period (Yeh, 1995). For the goose raising industry, the most important needs and benefits were to enhance the reproductive performance, to extend the breeding season throughout the whole year, or to adjust the natal period to non-breeding period (Zeman et al., 1990; Sellier and Rousselot-Pailley, 1997; Wang et al., 2002a, b). The restricted feeding process (Sellier et al., 1994; Wang et al., 2002a, b), induced molting (Zimmermann et al., 1987; Koelkebeck et al., 1991; Rolon et al., 1993), or investigating the effects of lighting system on the reproductive performance of poultry were discussed in many previous studies. The effects of the lighting system was the most significant among the three methods. Hsu et al. (1990b) indicated that the laying period of geese could be effectively adjusted under the proper lighting system which was different from the long exposure time required by poultry such as chickens. Implementation of the lighting system to adjust the laying period for geese must be conducted inside a confined poultry building blocked from light (Yeh, 1995).

In Taiwan, the temperature of ambient air during the non-reproduction period was frequently above 35 °C. It will affect the

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feed intake and reproductive performance of geese. The purpose of this study was applying water pads for controlling the entering air temperature below 30 °C and wind speed equaling 2 m/s. The effect of the reproductive performance would be discussed by adjusting the production period of White Roman geese with short term illumination system and feed control. The geese natal period would be adjusted to the non-reproduction period (April to September). The reproductive performances such as the laying period, laying rate, egg production, breeding egg fertilization rate, breeding egg hatchability, and the gosling number would be expected existing the same or better level by comparing with those of the normal production period geese. An effective way of adjusting the natal period would be provided and examined in this study.

Thus the objectives of this study were applying environmental control technologies (inlet temperature below 30 °C, short term illumination for 9 h after onset laying of geese and feed control) for comparing the reproductive capacity, the reproductive period and adjusting the period of the breading geese among three production types. Period adjustment with a water pad windowless building set (set A, adjusting production period from April to September with environmental control technologies), natal period adjustment with tradition open building set (set B, adjusting production period under natural environment from May to July) and natural period with tradition open building set (set C, normal production period under natural environment from October to the next May).

The reproductive performances of breeding geese would be analyzed and evaluated including the laying period, the average laying rate, the hatchability, the fertilization rate, the average egg production number per female goose and the average product gosling number per female goose.

2. Materials and methods

2.1. Animals

White Roman geese which hatched out in July (summer) were raised in 24-h light exposure at first 1–2 weeks. After three weeks, geese were bred in the natural light environment. A total of 7136 White Roman geese (5947 female geese and 1189 male geese) at 68 weeks of age were randomly divided into 3 sets: the period adjustment with a water pad windowless building set (set A), natal period adjustment with traditional open building set (set B) and natural period with traditional open building set (set C). The goose number of male and female ratio of each set was 1–5. Throughout the experiments, the geese were fed normally in a confined area. There were 930 female geese and 186 male geese raised in a building with an area of 61 m (L) × 17.6 m (W) and gutter-style pools (61 m (L) × 2 m (W) × 45 cm (D)) for set A. The water pad was a continuous surface with dimensions of 1.83 m (L), 17.6 m (W) and the 15 cm (D). The efficiency of the water pad was 70% with wind speed of 2 m/s. The ventilation rate was 649.6 m^3/min with the static pressure at 0.1 inch-Hg by six industrial fans (122 cm × 122 cm, Fan 1 ~ Fan 6). A shading panel with a wind resistance rate of 10% was installed 1 m in front of the fan. Air deflectors were installed in the goose building at the distance of 12.2 m adjacent to each other, and the distance from the ground was 1.66 m. The wind speed was 2 m/s when all fans were switched on. The switches, controlling the operation of the fans and the water pad, were evaluated by the outlet air temperature of the water pad inside the building. The temperature in the goose building was set at 22 °C for the minimum ventilation inside the goose building by turning on the Fan 1. When the outlet air temperature was lower or equal to 22 °C, only Fan 1 would be operated. An additional fan would be switched on by an increment of each one degree Celsius for the outlet air temperature until it reaches 27 °C while all the six fans would be turned on. The water pad would be switched on to reduce the inlet air temperature when the air temperature at the water screen outlet reached 28.5 °C. The inlet air temperature was controlled below 30 °C, and wind speed was controlled at 2 m/s during the summer time.

There were 850 female and 170 male geese in set B, and 4167 female and 833 male geese in set C. Geese in both sets were raised in the traditional open building. The 20 W cold white fluorescent lamp was used as the artificial light in the building, and the light intensity was near 30–40 lux at the position of the goose head as the goose stands up.

2.2. Experiments

The experimental method was shown in Table 1 for adjusting the natal period of the White Roman Goose. The 68 week-old geese were moved to different sets. The methods of adjusting the natal period in sets A and B were based on the methods in Cheng et al. (2005). The adjustment was begun on November 13, 2006. The goose onset laying would be induced by lighting schedule and the feed control in set A, and the 9-h photoperiod would be maintained during the post-natal stage. The goose onset laying was induced by the feed control in set B, and the natural lighting would be maintained during the post-natal stage. The exposure time was increased from 11.5 to 13.5 h. The experiment of set C was started on June 4, 2007. The geese were raised in the traditional way, and the natural lighting was conducted throughout the experiment. The exposure time was decreased gradually from 13.5 to 11.5 h, and then increased again back to 13.5 h during the post natal stage. The restricted feed treatments (150 g/day each) would be conducted in each set during the pre-natal period. The unlimited feed treatments would be provided before the laying period. The restricted feed treatments were 14.1% CP and 2604 kcal/kg ME, and the unlimited feed recipes were 17.8% CP and 2850 kcal/kg ME.

Table 1 showed the initial dates of experiment and modulation methods of laying period for three production types.

2.3. Measurements

The naturally copulation of the White Roman goose was implemented throughout the experiments. The laid eggs were collected and recorded every day. The laying period was defined as the beginning at 5% the daily egg laying rate, and the ending at 10% after the egg laying peak. A batch of eggs collected once a week was hatched by an automatic incubator. The temperature of the incubator was set at 37.7 °C for the first day to the fourteenth day, 37.5 °C for the fifteenth day to twenty-eighth day, and 37.2 °C afterward. The definition of fertilization rate of eggs was the percentage of fertilized eggs on the tenth day batch among the total hatched eggs. The hatching rate was defined as the percentage of goslings hatched from each batch among fertilized eggs.

2.4. Statistical analysis

The general linear model program of the SAS statistical analysis system was employed to analyze the experimental data. The differences between treatments were determined by the minimal significant difference test with a significant level of 0.05.

3. Results and discussion

3.1. Adjusting the laying period

After the natal period adjustment test of the white Roman breeding geese, the laying curves of each set breeding geese during