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NATURAL SHADING AND PRODUCTIVITY INDEX OF BROILER CHICKENS

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ABSTRACT: The appropriate use of natural resources in the design of broiler houses provides a reduction in farming operating costs and optimization of production conditions. Therefore, the natural shading around the broiler house can be an alternative for improving internal conditions of comfort. This study verified the efficiency of natural shading in the broiler productivity index (PI) in East-West oriented commercial housings. The PI of 32 commercial broiler houses in five flocks divided throughout a year was compared. The sheds had the same management, density and the same structural features, except from tree shading: on the North face; on the South face; on both faces and without shading. It was observed that broiler house in East-West direction with shading on the South face had higher productivity index compared to houses with shading only on the North face or on both sides, between autumn and spring. For the summer period, sheds without shading showed productivity indexes superior to others.

KEYWORDS: Tree-shading, ambience, broiler houses, broiler industry.

SOMBREAMENTO NATURAL E O ÍNDICE DE PRODUTIVIDADE EM FRANGOS DE CORTE

RESUMO: A correta utilização de recursos naturais na concepção de galpões avícolas proporciona redução nos custos operativos da granja e otimização das condições de produção. Assim, o sombreamento natural no entorno das instalações pode ser uma alternativa para a melhoria das condições internas de conforto nos galpões. Este trabalho verificou a eficiência do sombreamento natural no índice de produtividade (IP) de frangos de corte, em galpões orientados no sentido leste--oeste. Foram comparados os IPs de 32 galpões, todos com o mesmo manejo, densidade e com as mesmas características construtivas, exceto pelo sombreamento arbóreo: na face norte do galpão; na face sul; em ambas as faces, e nenhum sombreamento. Foram considerados cinco ciclos de criação divididos ao longo de um ano. Observou-se que galpões orientados no sentido leste-oeste, com sombreamento na face sul, apresentaram índice de produtividade superior aos galpões com sombreamento somente na face norte, ou nos dois lados, nas estações mais amenas do ano, entre outono e primavera. Para o período do verão, galpões sem sombreamento apresentaram índice de produtividade superior aos outros.

PALAVRAS-CHAVE: Sombreamento arbóreo, ambiência, granjas de frango, avicultura de corte.

INTRODUCTION

Well-designed broiler houses directly reflect on productivity increase, through savings with artificial conditioning devices, which means greater agility in daily employed handling. Thus, constructions must be planned and constructed to minimize environmental impact and to offer better conditions of animal development.

Natural or artificial shading consists in an efficient solution to attenuate sunstroke effect on these installations. According to BOND et al. (1976), shading might reduce, in many regions, around 30% of radiant heat load (RHL) on the animal. For GREY & DENEKE (1978), the

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contribution of trees as protection against solar radiation is significant, once trees and other vegetables reflect, absorb and transmit radiation and, by means of photosynthesis fixate energy, influencing environmental conditions. However, TINOCO (2004) highlights that, without appropriate shading by trees, this effect might become negative for poultry as it reduces natural ventilation inside the sheds.

An efficient shading project must consider the time of the year, latitude and longitude of the location, as well as dimensions and shed format. The relations between azimuth and solar altitude must be taken into consideration in order to determine the sun relative position in the celestial dome and shade projection factors (MOURA & NÄÄS, 2000). The characterization of seasons of the year is directly connected to Earth's axis inclination in relation to sun's positioning. Therefore, the installation orientation is affected by radiation intensity that reaches its surfaces throughout the day (SILVA, 2000).

In East-West oriented broiler houses, in the summer, the North and South faces receive together only half of the radiation obtained by East and West faces. In lower latitudes, these differences are more pronounced and in cases of atypical winters, the North face of an installation will be more affected in terms of irradiation (MOURA, 2001). ALVES & RODRIGUES (2004) verified that shading provided by trees in broiler houses was more effective when the installation is oriented in North-South direction compared to East-West, in which the internal shading area becomes practically inexistent, with shading only the external area of the housings.

In Brazil, most of broiler houses in use lack artificial mechanisms of environment conditioning, at the time that the natural heat conditioning that these houses exert might be a differential in terms of productivity of broiler chicken. Therefore, the aim of this study was to evaluate shading efficiency on broiler houses in productivity indexes of broiler chicken.

MATERIAL AND METHODS

The study was conducted in 32 commercial broiler houses in the Integrated Production Center of Sertanejo Ltda Company. Located in the city of Sertãozinho-SP (21º08'S, 47º40'W), with 540 m of altitude, climate classified as Aw and characterized as tropical with rain showers, according to Köppen classification. The winds during the winter are predominantly from Southeast direction (SE), except from December to February, when there is also predominance of Northwest winds (NW). The climate normal of the location and period of study can be visualized on Figure 1.

This production center comprehends 52 broiler houses, from which 32 were used in this study. The choice was made based on construction similarities, as well as other criteria such as tree shading, proximity, silo feeders and hygienic-sanitary handling (always conducted by the same team), absence of sanitary commitments or high mortality indexes, inbound and outbound of batches at the same time and same material used as manure in all broiler houses (peanut shells).

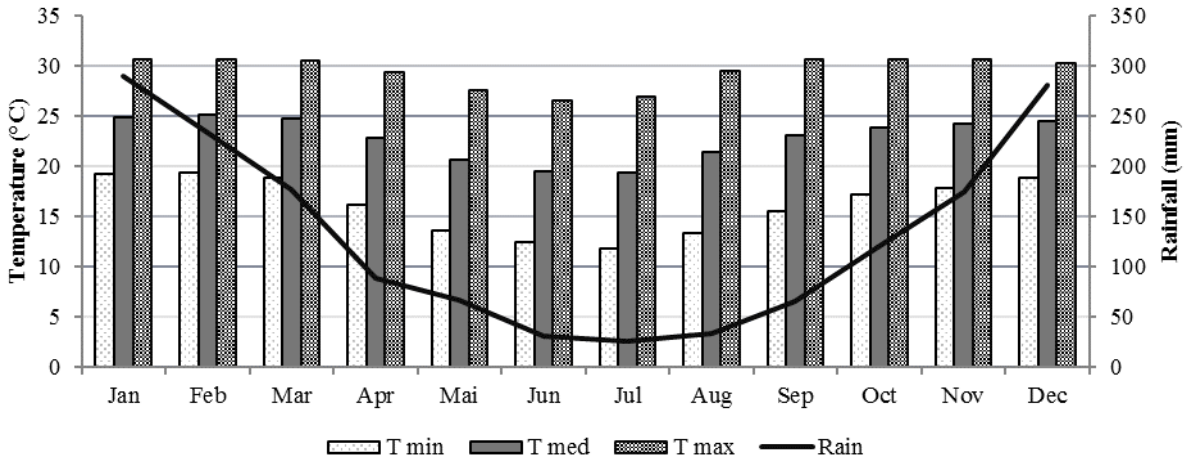

FIGURE 1. Climate normal of Sertãozinho-SP in the year 2005 (Source: CEPAGRI UNICAMP).

All broiler houses presented the same type of coverage, which is, fiber-cement tiles of channel type, lined with plastic canvas of yellow coloration an without skylights. The high ceiling was of around 2.8±0.2m and the ratio between length and width was nearly 1:10. Regarding ratio between width and height, it was approximately 1:5, in such a way that their proportions were similar. The animal density was of 13 broilers/m² and all animals would enter in the beginning of cycle and leave for slaughter at the same time, with 49 days of age (*all in/all out*).

The only conditioning artifice in each shed was fans with direct driving (without belt) with six metal shovels. A farmer responsible for the center manually carried out the driving of fans and the used parameter was the internal temperature of each broiler house, monitored by mercury thermometers with minimum and maximum, located near the entrance door.

The sheds were constructed in East-West direction and tree shading was made with Leucaena species (*Leucaena spp*), planted at approximately 1.5 m of distance from lateral walls of the sheds. This specie is characterized as a small-sized tree, of fast growth and wide distribution in Latin America (Global Invasive Species Database, 2010).

The productivity index (PI) was compared in sheds that presented tree shading: in the North face (N), in the South face (S), in both faces (2F) and without tree shading (without). They were compared from February 2005 to February 2006, with five flocks, described on Table 1, already considering the depopulation period (the poultry would leave with 49 days and the depopulation period, cleaning and maintenance of sheds was of, approximately, 20 days).

TABLE 1. Breeding cycles of batches.

Batch	Period
1	February, March, April,
2	May, June, July
3	July, August, September
4	October, November, December
5	December, January, February

In order to evaluate boiler productivity, the productivity index was used (PI), which considers the ratio between the viability product (VB) and the animal average weight (AW) by the product of feed conversion (FC) and age of animals (AA), according to [eq. (1)]:

$$PI = (VB \times AW)/(FC \times AA) \quad (1)$$

The viability was calculated through the ratio between the final number of animals and the initial number and the feed conversion determined through ratio between the total consumption of animal ration and the total weight gain, according to observations from eqs. (1) and (2). In this study, internal temperature of each shed was not evaluated.

$$VB = (Final\ number\ of\ broilers/Initial\ number\ of\ broilers) \times 100 \quad (2)$$

$$FC = Total\ consuption\ of\ feed/Total\ weight\ gain \quad (3)$$

For average comparison purposes, analysis of variance was carried out (ANOVA), with Tukey test and orthogonal contrasts for comparison of PI averages for each flock throughout the year, as well as evaluating the effect of shading presence *versus* absence and comparing shading in North face *versus* South face, through F Test. The software used was SAS® (Statistical Analysis System, 9.0 version), with Mixed procedure.

RESULTS AND DISCUSSION

Figure 2 displays average PI for housings with shading on both sides (2F), in North face (N), in South face (S) and without shading (without) in each breeding cycle of batches. Differences were observed in PI of batches 2, 3 and 5, reared in periods from May to July, July to September and December to February, respectively.

In batches 1 and 4, no significant differences were observed in PI among shading and no shading housings and neither between faces North and South. Batch 1 presented higher values of PI compared to others and less variation between the situations, which can be attributed to weather and environmental conditions that are favorable to broiler rearing at this time of the year, with little influence of shading.

This information is justified by FURLAN & MACARI (2002), who affirm that, with lower energy expenditure due to homeostasis maintenance the animal allocates the additional input of this energy to meat production, as observed, temperature conditions (average of 25°C) and relative air humidity (early autumn) were favorable to production.

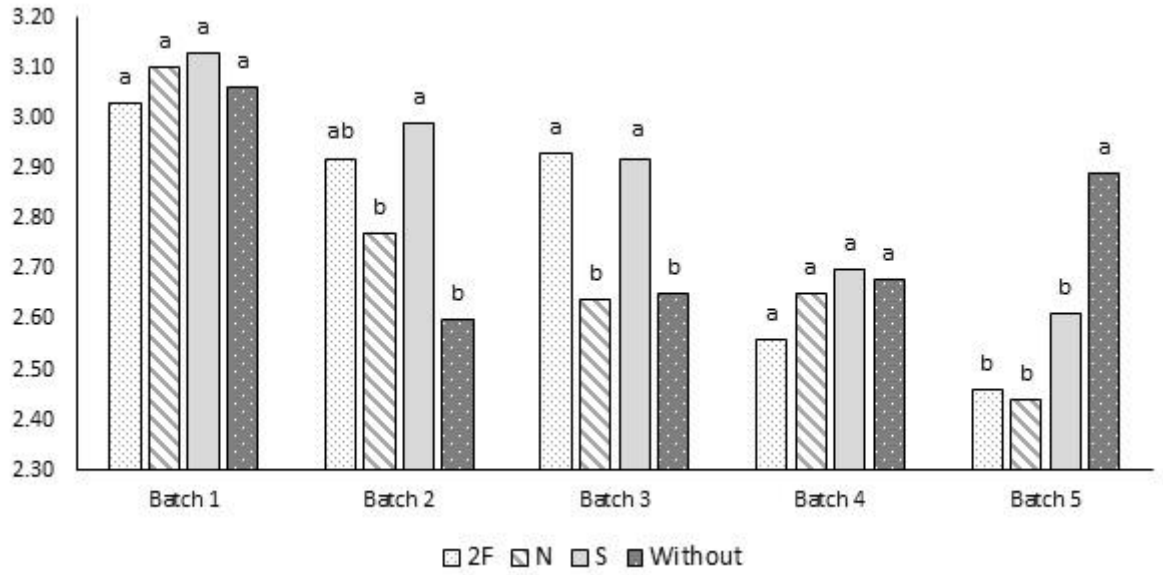

FIGURE 2. Production indexes per batch, in housings with shading in both faces (2F), only in North face (N) or South face (S) and without shading (without). Lowercase distinct letters demonstrate statistical differences (Tukey, $Pr \leq 0.05$).

Regarding batch 2, the housings with shading on South face presented PI superior to in other situations. At this time of the year, the air average temperature is below 20 °C and, due to solar declivity; there is greater incidence of solar radiation directly on North façade, which is free from trees. It enables more heating of the housing, which, according to TINOCO (2004), is advantageous, also favoring natural ventilation keeping one face of the shed hotter than the other is.

Considering batch 3, reared from July to September, the shading on South face presented the same efficiency than on both sides for the same batch, with superior values of PI to sheds without shading and N. In these months, like in batch 2, a beneficial effect of sun incidence on installation occurs and, there is predominance of winds from SE, which are blocked by trees disposed on S and on 2F of installation.

At this time of the year, due to parallel displacement of Sun's apparent path to the North, sheds with tree shading S enabled entrance of sunlight directly on installation and no projection of shade on roof occurred. This situation demonstrated to be as effective as presence of trees on both sides, even though the sun do not go through the installation. However, trees in South face (both in S and in 2F) prevented cold winds from SE, which can be proved as the situation N and without shading presented the worst indexes in this period.

In batch 4, the broilers were reared from October to December and there was no difference among the PI. The poultry from this batch were reared in a period of the year characterized by averages temperature around 25°C and a gradual increment of relative air humidity, contrarily to what occurred in batch 5, in which the broilers were reared during the summer, characterized by high temperatures and heavy atmospheric precipitation, elevating relative air humidity.

In batch 5, sheds without shading presented superior PI values compared to others housings with some type of shading. At this period of the year, three factors directly influence shading action on housings: high temperature, humidity, and lower sun declivity, in other words, there is greater incidence of solar radiation directly on the housing's ridge.

The shading on batch 5 was little efficient as the shading projection of trees do not fall upon directly on housings' roofs (average sized trees), but on the laterals. Another influence factor was the ventilation efficiency, which is directly related to air exchange capacity in a certain period, as it could have been affected by the natural barrier of trees.

It is also known that, during evapotranspiration, trees promote an increment of air humidity (GREY & DENEKE, 1978), elevating even more the humidity around and inside the housings, which can affect animal thermal exchanges by latent mechanisms, mainly when combined with high air temperatures in the interior of sheds (SEVEGNANI et al, 2001).

CONCLUSIONS

Installations oriented to East-West direction with shading on South face presented productivity index superior to sheds with shading only on North face or on both sides in milder seasons of the year, between autumn and spring. In summer season, shading was not efficient.

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