ABSTRACT

Achievement of maximal yield from the fowl that reached a certain level of biological evolution is influenced by many factors, inclusively by the provided husbandry conditions, through the appropriate technologies of rearing and exploitation *(Vacaru-Opriş, I. et al., 2000).*

These technologies are differentiated through the ways used to ensure optimal levels for all environmental factors, in order to fulfil the specific and real requirements of fowl, to allow them to express the production potential at its best level *(Usturoi, M.G., 2008).*

High influence on production and reproductive performance of fowl is exerted by the lighting schedule, knowing that among all domestic animals, birds are the ones that give best responses on the light stimulus, throughout all of their lifecycle *(Classen, H.L., 1998).*

In "Ross" breeders, photostimulation is onset 4 weeks prior to laying beginning and suppose sudden increase of daylight length from 8 hours, tils 11 hours/day during the 20th week of life. Then, lighting is extended an hour every 2 weeks, till fowl reach the age of 27 weeks, when lighting length reaches 15 hours a day. Its intensity is provided at 30-60 lux and should increase as photostimulation schedule advances; mixed increasing of lighting period and intensity will stimulate the sexual maturity onset and subsequently reproductive performances.

The experience of farming "Ross-308" breeders indicated that for all birds groups – homogenous, heterogeneous or less homogenous – the onset of photostimulation prior to the age of 20 weeks does not allow the fowl to complete the body development, leading to high levels of culling, due to prolapses.

In order to achieve the goals in the doctoral studies – the optimising of lighting schedulein meat type Ross breeders fowl, the grouping methods was used, mixed with the periods one, throughout the 3 experiments we organised; the experimental factors were represented by photostimulation onset moment, by daily lighting duration and intensity:

4. **Experiment 1:** ***Contributions on the optimisation of the lighting schedule provided to "Ross-308" breeders, using belated photonic stimulation***. The experiment comprised 11.992 breeders, parents of "Ross-308" chicken broiler, allocated in 2 groups: a control group (Lc-1) and an experimental treatment (Lexp-1); each group included 5260 hens and 736 roosters.

5. **Experiment 2:** ***Contributions on the optimisation of the lighting schedule provided to "Ross-308" breeders, using early photonic stimulation***. It also comprised two groups (Lc-2 and Lexp-2), with an identical fowl amount (5260 hens+736 roosters/group). The photostimulation was onset earlier in the experimental group (L2exp).

6. **Experiment 3:** ***Verifying of the best lighting schedules provided to "ROSS-308" breeders, as found in the previous experiments (no. 1 and no. 2).*** Two experimental groups were established (Lc-3 and Lexp-3), each one including 5996 adult "Ross" breeders (5260 hens+736 roosters/lot).

The assessment of productive and reproductive performances of the fowl studied during the three experimental series was done throughout a period of 40 weeks, starting from the fowl age of 20 weeks and ending after they turned 60 weeks old. Thus, there were investigated many parameters which dealt with husbandry conditions and morpho-productive performances, quality of incubation eggs, hatching results and economic efficacy of the applied photostimulation schedules.

The accommodation of the fowl studied in the three experiments was made in two halls (area of 1200m2 each, identical as endorsements) and placed one nearby to another. Each hall included a sas room on the centre, which divided it in two halves. Every half included 4 (four) compartiments of reproduction, with bouns of wired net.

Halls floor was covered with permanent litter, clean and dry, with certain equipments hanged above: watering devices, D.N.C. feeding system and tronchonic feeders (50 cm higher) for males. Feeding room was provided at 8.5 cm/hen and at 18 cm/hen, while the room for water intake reached environ 3.0 cm/capita. 2 levelled nests (1 nest at 4 females) were deployed in the breeding compartments.

Initial sex ration reached 9.5-10.0 roosters/100 hens then reduced, as hens laying intensity decreased, reaching thus 6.0-6.5 roosters/100 hens when they turned 60 weeks old.

Researches in **experiment no. 1** were done on "Ross-308" hybrid parents, exposed to belated photostimulation schedule.

Concerning the microclimate factors in both halls which accommodated the experimental groups, multiple deviations from the technological comfort area were signalled. Thus, environmental temperature varied between +14.53....+15.38^{o}C, during the 22nd week of life and between +26.87...+27.35^{o}C, during the 45th one, compared to +18^{o}C, the optimal temperature for meat type breeders.

Air relative moisture presented large variations, compared to the comfort area, oscillating between 52.21-53.39% (44th week) and 83.21-84.01% (22nd week), as influenced by the external air moisture and rainfalls.

Pollutants concentration in both halls progressively increased since the experiment onset. However, it not pass over the dangerous levels for poultry health. Fowl body weight increased as they turned old. Till the age of 32 weeks, the hens in both groups complied with the standard weight curve; after this, their body mass slightly exceeded the upper admitted limit and began lay during the 26th week of life. In males, controlled feeding and the appropriate sex ratio allowed their maintenance on the standard curve, throughout all periods.

Concerning flock liveability, it was found within normal limits, the casualties reaching 9.09% in control group (Lc-1) and 9.36% in the experimental one (Lexp-1). In males, mortality was lower, just 1.40% in Lc-1 group and 0.87% in Lexp-1 group. Although laying peak was reached in the 32nd week of fowl life, eggs yield was very well, meaning 172.01 eggs/hen in control group (Lc-1) and 176.70 eggs/hen in experimental group (Lexp-1).

Average feed intake was established for the whole period comprised between 20 – 60 weeks: 150.35 g/hen/day in control group (Lc-1) and 149.75g/hen/day in experimental group (Lexp-1).

Feed conversion ratio was calculated at 281.49 g feed/egg in control group (Lc-1) and 271.26 g feed/egg in Lexp-1 group, meaning 3.64% less in this group, compared to Lc-1.

Quality of the eggs produced by the hens in both group was, in all situations, better in the experimental group, compared to control. Thus, during the first week of laying, the eggs with morphologic anomalies reached 2.35% from total in Lexp-1, compared to 2.44% in Lc-1 group.

Eggs weight increased as hens turned old, reaching the maximum of 65.51-66.24g when production ceased.

Eggshell breaking strength was positively correlated with its thickness, being better in laying onset (0.340-0.342 kg f/cm^{2}) compared to its ceasing (0.325-0.326 kg f/cm^{2}).

Haugh index was correlated to eggs weight being much higher during laying end (88.58-89.07 UH) than in its onset (73.91-74.59 UH).

Analysis of incubation process revealed that embryonic development passed better in the eggs from Lexp-1 hens than in those laid by the hens in Lc-1 group, knowing that they also had better fertility. Thus, in Lc-1 hens, fertility varied between 87.59%-laying onset and 93.04%-laying peak, while in Lexp-1 group, the same treat reached 87.88-93.60%.

Hatching percentage oscillated between 66.09-84.46% in Lc-1 group, respectively 66.95-85.05% in Lexp-1 group.

Quality of new hatched chickens was higher in experimental group (Lexp-1), through day old chickens weight (36.68-45.06g, compared to 35.59-44.24g in Lc-1 group) and Ist quality class allocation (85.73-99.19%, compared to 81.52-98.65% in Lc-1) group. The difference came from higher quality of incubation eggs laid by hens in experimental group (Lexp-1), therefore from better embryonic development.

In Lexp-1 group, exposed to belated photostimulation, the revenue reached 56,367 RON, compared to 27,664 RON only, achieved in Lc-1 group (hens stimulated in accordance with "Ross" company specifications).

In experiment 2, the researches also used breeders, parents of "Ross-308" hybrid, exposed to early photostimulation schedule.

Microclimate factors in both used halls presented many deviations from "Ross" company specifications.

Concerning the environmental temperature, it oscillated between +14.51...+14.55^{o}C (February) and +26.43...+26.77^{o}C (August), compared with the optimal level of +18^{o}C, to be assured for breeder hens.

Relative air moisture varied in wide limits, compared to the technological comfort limits, being correlated to the outer moisture and rainfalls during the analysed period; variation limits were of 51.19-51.44% (44th week) and 82.41-83.10% (22nd week).

Concentration of pollutants in halls evolved throughout the studied period and did not reach dangerous levels for the fowl.

Generally, fowl weight was maintained on the standard curve. Knowing that females began to lay later (26th week of life), their weight slightly pass above the maximal admitted limit and came back to normal since the 52nd week. In males, controlled feeding and sex:ratio maintenance did not allow them to pass over normal weight limits.

Flock liveability was found within normal limits: 8.6% in control group (Lc-2) and just 7.3% in experimental group (Lexp-2). In males, mortality was much lower, reaching 1.51% in control group (Lc-2) and 1.10% in experimental group (Lexp-2).

Eggs yield reached good levels, of 172.64 eggs/hen in control group (Lc-2) and 175.24 eggs/hen in experimental group (Lexp-2).

For the entire studied period (20-60 weeks), average feed intake was calculated at 173.89g/hen/day in control group (Lc-2) and at 180.81g/hen/day in the experimental group, (Lexp-2), while feed conversion ratio (g feed/egg) presented values of 267.14 in Lc-2 group and just 266.21, in Lexp-2 group.

Concerning the quality of produced eggs, it was better in Lexp-2 group, than in Lc-2 one, appreciated through the values of quality traits of the eggs studied during laying ceasing. Thus, participation of eggs with morphologic anomalies reached 1.97% in Lexp-2 group, compared to 2.44% in Lc-2 group, while eggs weight was measured at 66.01g in Lexp-2 and 65.81g in Lc-2 group.

Eggshell breaking strength decreased toward laying end (reversely correlated with shell thickness) and was better in the eggs from Lexp-2 (0.330 kg f/cm^{2}), than in those from Lc-2 (0.325-0.326 kg f/cm^{2}). Haugh index presented and average value of 88.77 H.U in Lexp-2 group and of 88.08 H.U in Lc-2 group.

The analysis of incubation process indicated better fertility and better embryonic development on Lexp-2 eggs. Fertility reached levels of 88.56-94.17% in the eggs produced by Lexp-2 hens, compared to just 87.65-93.56%, as recorded in Lc-2 group.

Hatching percentage oscillated between 71.06-86.21% in experimental group (Lexp-2), respectively between 69.24-84.92% in control group (Lc-2).

The quality of the new hatched chickens followed the same trend. Thus, day old chickens weight was of 36.27-44.15g in experimental group (Lexp-2) and of 35.22-43.85g in control group (Lc-2), while the participation of chickens in Ist quality class was situated at a level of 84.86-99.59% in Lexp-2 group and of 81.07-98.42% in Lc-2 group.

Concerning the economic efficacy, the photostimulation schedule applied to Lexp-2 hens, improved their performances and increased revenues, compared to the classical technology usually applied in “Ross-308” parents - control group (Lc-2). Thus, in Lexp-2 group the revenue reached 56,872 lei, which meant53.22% higher than the one in the Lc-2 group (26,603 lei).

Experiment 3 aimed to comparatively assess the productive and reproductive performances of “Ross” breeders, exposed to photostimulation schedules, in different stages of their life.

This experiment verified the best results achieved in previous trials. There were established 2 groups - a control one (Lc-3), with belated photostimulated schedule and an experimental one (Lexp-3), with early photostimulation schedule, knowing that both generated best morpho-productive and financial results during the previous trials.

The microclimate factors provide to the fowl presented certain deviations from the “Ross” company specifications. Thus, the environmental temperature recorded minimal values of +14.90....+14.98^{o}C-February and maximal ones of +26.88...+26.94^{o}C in August, while the relative moisture varied between 52.33-52.52% in August and between 80.60-80.87% in March.

Pollutants concentration in halls was increased toward the experiment ceasing, as a consequence of litter degradation. No dangerous levels were recorded. These oscillations as well as slightly differentiations between rearing halls, were influenced by the dynamics of environmental factors and by flock liveability.

Fowl body weight was found within the standard specific curve of this category. In females, photostimulation schedule applied in Lc-3 group induced the correlation between sexual maturity onset and optimal body development, thus in the end of experiment, these presented 1.24% higher body weight than in the experimental group (Lexp-3). The males achieved body weights close to the standard curve, knowing that restrictive feeding was applied, combined with an appropriate sex ratio value.

Flock liveability was within normal limits, mortality reaching 8.82% in Lc-3 group and 7.48% in Lexp-3 group. In males, mortality rate was lower, reaching 1.10% in Lc-3 group and 1.61% in Lexp-3 group.

Eggs yield of the hens in Lc-3 group reached 176.9 pcs./hen, compared to just 175.3 eggs/hen in Lexp-3, while average daily feed intake was calculated at 162.4 g/hen/day (164.7 g/hen/day in Lexp-3 group) and feed conversion ratio of 270.5 g feed/egg (273.8 g feed/egg la lotul Lexp-3).

Although no significant differences occurred between groups for eggs quality, better results issued from the hens exposed to belated photostimulation (Lc-3 group). Thus, average proportion of eggs with morphologic anomalies reached 1.16% in Lc-3 group and 1.21% in Lexp-3 group, while eggs weight reached 59.01 g in Lc-3 and 58.55 g in Lexp-3. Shell breaking strength was calculated at 0.338 kg f/cm^{2} in Lc-3 group, compared to 0.335 kg f/cm^{2} as recorded in Lexp-3 group, basing on an improved eggshell thickness (0.409 mm vs. 0.403 mm). Haugh

index was situated at average levels of 84.48 U.H. in Lc-3 eggs and 84.22 U.H. in Lexp-3 groups.

Lighting schedule applied in control group (Lc-3) provided better fertility and higher eggs quality, therefore better embryonic development, compared to the situation in Lexp-3 group. Therefore, fertility level was situated at 90.21-95.00% in Lc-3, compared to just 89.57-94.62% in Lexp-3 group, while hatching percentage reached 72.26-87.05% in Lc-3 group and 71.33-86.47% in Lexp-3 group.

Quality of the new hatched chickens proved the better conditions provided to the breeders in control group (Lc-3). Thus, day old chickens weight reached 41.4 g (compared to 40.92 g in Lexp-3 group), while the proportion of chickens belonging to Ist quality class reached, in average, 94.85% (94.31% in Lexp-3 group), while of those in IInd class reached just 5.15% (5.69% in Lexp-3 group).

Photostimulation schedule we used in control group (Lc-3) allowed the achieving of a revenue of 58,370 lei, 3.35% higher than that obtained after early photostimulation, in Lexp-3 group (56,417 lei).

Certain interesting conclusions issued from the three experiments we organised in order commercial broilers.

1. Level of microclimate factors from husbandry halls presented certain deviations, compared to “Ross” company specifications, mainly due to the lack of climate control and less, to the variable load of hens on surface unit, generated to the compulsory fulfilling of density requirements, as influenced by fowl age.
2. Relatively to the hens body weight, the data we achieved indicated their keeping on the specific weight curve, with some insignificant variations.
3. The hens from groups Lexp-1 (experiment 1) and Lc-3 (experiment 3), exposed to belated photostimulation achieved average eggs yields (20-60 weeks) of 176.80 pcs./hen, which meant 0.87% higher than that achieved by the early photostimulated hens (175.27 eggs/hen) from groups Lexp-2 (experiment 2) and Lexp-3 (experiment 3), respectively 2.53% better than the production of hens that received conventional photostimulation schedule - groups Lc-1 (experiment 1) and Lc-2 (experiment 2) (172.33 eggs/hen).
4. Feed conversion ratio (g feed/egg) presented different values (presented in decreasing), of 270.01 in the hens which received belated photostimulation, of 270.88 in those exposed to early photostimulation, respectively of 274.32 in those which received conventional lighting schedule.
5. The hens exposed to belated photostimulation (groups Lexp-1 and Lc-3) produced eggs with better quality features than those issued from early photostimulated fowl (groups Lexp-2 and Lexp-3). Relevant values were achieved for Haugh index (general unit used in assessment of incubation eggs quality), which was 1.38% higher in the eggs laid by groups Lexp-1 and Lc-3, compared to the referential groups (Lexp-2 and Lexp-3).
6. Lighting schedule experienced in groups Lexp-1 and Lc-3 (belated photostimulation) exerted its beneficial influence on the embryonic development, resulting 0.95% better hatchability than in other groups (Lexp-2 and Lexp-3); the higher performance was given by 1.07% higher fertility and 0.43% less embryos mortality, in the eggs laid by the hens in groups Lexp-1 and Lc-3.
7. The eggs laid by the hens exposed to belated photostimulation (groups Lexp-1 and Lc- 3) hatched 0.29% more chickens which belonged to the Ist quality class, having 1.25% better body weight than those hatched from the eggs issued from hens exposed to early photostimulation (groups Lexp-2 and Lexp-3).

8. Economically, both lighting schedules we experienced generated revenue. However, the belated photostimulation, applied in Lexp-1 and Lc-3 groups, allowed to achieve net revenue of 57,369 lei, compared to 56,645 lei as observed in the early photostimulated groups (Lexp-2 and L2xp-3 groups) respectively just 27,134 lei in those hens stimulated in accordance with the classical technological lighting schedule.

The conclusions presented above allowed us to depict the way in which certain different photostimulation schedules influenced the performances of “Ross-308” broiler breeders. Certain recommendations have been also elaborated:

• postponing a week the photostimulation onset for “Ross-308” breeders, in order to allow proper body development, correlated with intense laying. Thus, photostimulation of the genotypes we studied should begin at 21 weeks old, instead of 20 weeks old, as actually practiced in broiler breeders farms from our country;

• providing a lighting intensity of 60 lux since the very beginning of the photostimulation schedule, in order to reach reproductive maturity on optimal time;

• compulsory maintenance of an appropriate sex ratio throughout the entire laying period, in order to ensure highest possible fertility percentage;

• brooding of halls with homogenous fowl, as body development, as guarantee of better flock liveability;

• necessity to regulate the environment climate in breeders, to ensure that the energy from feed is directed towards the main production instead of individual homeostasis;

• balancing of mixed feed recipes for energy and nutrients, in order to provide requirements for maintenance and high eggs yields, with best incubation features.

Within the presented conjuncture, the optimal photostimulation schedule for “Ross-308” broiler breeders, reared in Romania (one of the most appreciated hybrids designed for meat production), is presented below, as issued from original trials:

• onset of photostimulation process when hens turn 21 weeks old, in order to reach 11 hours of light/day (instead of 8 hours/day during previous stages) and light intensity of 60 lux/m^2;

• increasing of daylight length during the 22^{nd} week of fowl life (12 hours light/day);

• continuously increasing of daylight length with an hour every 2 weeks, till 15 hours/day are reached (hens aged 28 weeks):

o 12 hours daylight time at 23 weeks;
o 13 hours daylight time at 24 weeks;
o 13 hours daylight time at 25 weeks;
o 14 hours daylight time at 26 weeks;
o 14 hours daylight time at 27 weeks;
o 15 hours daylight time at 28 weeks;

• preserving daylight length at 15 hours/day till the exploitation series ends, meaning fowl aged 60-64 weeks.