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Laying and Preservation of Hens of the Industrial Flock Depending on the Density of Their Placement in Cage Batteries

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Abstract. The relevance of this study is conditioned upon the lack of experimentally based data on optimising the density of laying hens of modern egg crosses in cage batteries of new multi-tiered structures. The purpose of this study was to determine the effect of the density of keeping chickens of an industrial herd in cages of 12-tier batteries on their egg production and safety. For this purpose, laying hens of 3 groups of the Hy-Line W-36 industrial flock of crossbreeds were kept in separate similar poultry houses, but at different densities. In particular, the hens of the 1st group were placed in cages at a density of 23 heads/m² according to the norms, and the 2nd and 3rd groups – at 26 and 28 heads/m², respectively, i.e., at a density of 13.0% and 21.7%. According to the characteristics of this cross, the laying capacity of hens of an industrial flock should be at least 262.2 eggs per initial laying hen for 62 weeks of life. However, in hens of Group 1, it was 231.4 pcs./head, i.e., it was 11.7% against the background of 5.1% lower preservation, which, if optimal paratypic conditions of existence were created, would correspond to the normative level (96.0%). When the density of housing was increased to 26 heads/m² (Group 2) and to 28 heads/m² (Group 3), the laying ability of hens was 220.8 pieces/head and 227.2 units/head with retention of 91.1% and 88.4%, respectively. An increase in the planting density of chickens of the 2nd and 3rd groups led to a decrease in egg production and safety but yielded more production per 1 m² of production areas. Additionally, 3.9-12.9 million eggs were obtained during the 43 weeks of the productive period, including 1.6-5.3 thousand per 1 m² of their area. Thus, the specified compaction can be applied as a technological method of rapidly increasing the production of edible eggs without the construction of new or reconstruction of existing farms in case of an added need for this product in the Ukrainian or foreign food markets

Keywords: production of edible eggs, productivity, cage equipment, laying curve, hens of egg crosses, live weight, housing conditions

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Introduction

Overcrowding of chickens in any type of housing (cage, floor, alternative, etc.) adversely affects their laying capacity and viability [1; 2]. Some researchers [3] consider this to be a consequence of chronic stress, which is formed and gradually increases (accumulates) during the uncomfortable keeping of laying hens during the period of productivity. In hens of industrial flocks of modern egg crosses, this period usually lasts up to 72 weeks, i.e., until they reach 90 weeks of age [4]. The density of their maintenance (or provision of an area) is regulated according to the standards of technological design in poultry farming – VNTP-APK-04.05 [5] and other regulatory requirements [6]. In particular [5], the stocking density of hens of an industrial flock of white-egg crosses in cage batteries should not exceed 22-25 heads per 1 m² of the floor area of the cage, which corresponds to providing them with an area of 400-450 cm²/head. However, developers of foreign breeding crosses [4], which are used for the industrial production of edible eggs in Ukraine, recommend keeping laying hens in cages under more comfortable conditions, at a density of 13-20 heads/m² (or 490-750 cm²/head) per the requirements established in their countries (USA, Canada, EU countries, etc.). Disregarding this recommendation due to an effort to obtain as much product as possible from 1 m² of available space, most Ukrainian food egg producers keep industrial flock hens in cages with a density of 22-25 heads/m² (400-450 cm²/head) per current standards [5]. Furthermore, to substantially increase the available production areas, some of them also resort to replacing the cage equipment for keeping chickens, namely 3-4-tiered batteries with 6-12-tiered ones. However, the effectiveness of using these multi-tiered cage batteries to produce edible eggs while keeping laying hens of modern egg crosses, extremely productive and at the same time demanding in terms of maintenance conditions, has not yet been investigated.

Under best living conditions, laying hens of modern egg crosses can lay up to 365 eggs per year [4], which is possible with daily ovulation of a new egg cell. Their wild ancestors (*Gallus bankiva*) usually lay only 3-9 eggs per year [7]. Over the 3-5 thousand years of breeding of domesticated chickens, humankind has created many populations and breeds, including specialised egg-laying crosses, the hens of which can lay eggs almost every day under certain conditions. They usually ovulate once a day, namely 30 minutes after laying an egg. Theoretically, it could occur up to 4 times a day, but under the conditions of laying eggs without a shell, for the formation of which the laying hen's body spends up to 19 hours of time [8].

Many factors influence the rhythmicity of the specified ovulatory cycle, and therefore the laying hens. Until recently, the most influential factor was the nutrition factor related to their supply of water and feed, its balance in terms of basic nutrients [2]. In modern times, the factor of stress is also considered to be very influential, which can affect laying hens at any time during a long productive period. Usually, a stressful situation, which arises, e.g., due to the restriction of access to water or feed, soon leads to aggressive behaviour of separate individuals, which suppress other laying hens of the flock. It is believed that stress factors can be infections, invasions, overcrowding, too high or

low air temperature, improper sanitary conditions of the environment and other irritants [2; 9]. New relationships between laying hens in stressful situations, which arise when they are kept in large groups (1-2 thousand heads) in sections of the poultry house, are more significant than small ones (3-30 heads) – when kept in cages [10]. These new relationships are mostly caused by the struggle for dominance in the flock or in a certain territory and can change from one behavioural form to another depending on the situational conditions of existence [11]. If there is an even supply of fodder on the holding area, the territorial form of the relationship between individuals of the flock prevails, and if there is an uneven supply of fodder or is a shortage, it is dominant. However, aggression and the establishment of new hierarchical relationships are inherent in both forms [12].

The body's reaction to the action of a stimulus (stressor) depends on the intensity and duration of its impact until the formation of characteristic signs, on the specificity of this action, biological features of the object of influence and other factors [13]. In any case, stressful situations require the body to spend more energy to adapt to new living conditions, changes in instinctive behaviour, which leads to a decrease in laying ability of hens by 19.3-28.8% due to disruption of the ovulatory cycle, their viability, and egg quality [14]. A wide range of behavioural, physiological, and immunological interdependent changes in the body of chickens are associated with a decrease in their egg-laying capacity due to the effects of stress factors [15]. Certain behavioural actions of hens in stressful situations are accompanied by a 34.7% decrease in feed consumption [16], disruption of the endocrine system, acid-base homeostasis, a decrease in antioxidant status, inhibition of the functions of individual organs and physiological mechanisms [2]. An increase in the level of corticosterone, norepinephrine, and adrenaline results in dysregulation of physiological processes related to steroidogenesis, i.e., growth, development of follicles, ovulation of eggs, and therefore egg deposition [17].

Stress is divided into 2 types, acute and chronic. They are similar in physiological mechanisms but differ in the duration of the stimulus and the intensity of the reaction to it. The acute type is characterised by an extremely elevated level of response, especially upon certain unexpected actions, such as catching laying hens during vaccination or transportation from one farm to another, upon changes in the housing method (from floor to cage or vice versa), upon unexpected turning off of the light in the poultry house, etc. Symptoms of chronic stress arise as a result of the action of a less powerful stimulus over a long period of time, i.e., gradually, not suddenly. The level of reaction under the periodic action of one or more irritants can be both insignificant and increase to an elevated level due to the deterioration of the conditions of keeping laying hens, the spread of a disease of a non-infectious nature in the flock, due to incorrect work of personnel or technological equipment [13]. Therefore, overcrowding, use of imperfect technological equipment or keeping under other unfavourable conditions leads to a decrease in laying and viability of hens, which is probably related to the occurrence of chronic stress in them.

The purpose of this study was to determine the compliance of the parameters of the stocking density, prescribed for chickens of the industrial flock by the norms of technological design in the poultry industry VNTP-APK-04.05 in force in Ukraine, to the needs of laying hens of the modern egg cross created in the USA for their maintenance in cage batteries of new 12-tier structures.

Materials and Methods

Research was conducted during 2021-2022 in the conditions of a modern complex to produce edible eggs of “YASENSVIT” LLC, located in the Kyiv Oblast. 3 groups of

laying hens of the “Hy-Line W-36” industrial flock of cross-breeds (Table 1) were formed from repair hens grown up to 16 weeks of age, which were kept in separate poultry houses with an area of 2,463.3 m², equipped with 12-tier cage batteries “Salmat” (Germany), comprising 30,912 cages with an area of 0.392 m² (0.70x0.56 m). The laying hens of the research groups in separate poultry houses were kept as a forced step due to their equipment with stations for automated collection, accounting, and conveyor transportation of eggs to sorting machines of the egg storage, which made it impossible to determine their number for each cage battery.

Table 1. Experiment scheme

Indicator	Laying hen group		
	1 (control)	2	3
Total number of cells, pcs.	30,912	30,912	30,912
Hens per 1 cage, heads	9	10	11
Number of hens in a group, heads	278,208	309,120	340,032
Density, heads per 1 m ² of cage floor area	23	26	28
Availability of cage area for hens, cm ² of cage area per head	435.6	392.0	356.4
Feeding front, cm per 1 head	7.78	7.00	6.36

Likewise, the number of dead and culled laying hens, the consumption of compound feed, water, and electricity were recorded separately for each poultry house every day.

Thus, a batch of 16-week-old repair hens that met the requirements of DSTU 4661 [18] were delivered from the breeding area to the industrial flock farm and divided into 3 groups. Hens of each group were placed in cages of the corresponding poultry houses according to the density per the experiment scheme (Table 1). By gradually increasing (by 15 minutes per day) the total length of daylight from 8 to 14 hours per day, they stimulated the beginning of their pregnancy when they reached 19 weeks of age. The experiment lasted 43 weeks, namely from the beginning of laying (from the age of 19 weeks) until reaching the age of 62 weeks. Hens were generously provided with complete ration compound feed that met the requirements of DSTU 4120 [19], the consumption of which, depending on the age of the hens, gradually increased from 73 to 102 g per head per day, as well as drinking water according to DSTU 7525 [20]. The parameters of the light regime, microclimate, and air exchange in the poultry houses throughout the experiment met the requirements of VNTP-APK-04.05 [5].

The number of eggs laid and the intensity of laying hens, the number of dead and culled laying hens were determined daily by group to determine the preservation of the stock. Once a week, the weight of eggs and the live weight of laying hens were measured from certain marked cages in a sample of at least 100 ($n \geq 100$). The efficiency coefficient of egg production depending on the density of laying hens was determined according to Equation 1 [21]:

$$E_{ec} = (1.4 \times M) - (0.35 \times K) \quad (1)$$

where E_{ec} is the efficiency coefficient, conditional units; 1.4 and 0.35 are constant values; M is the egg mass obtained per 1 laying hen, kg; K is the feed costs to produce 1 kg of egg mass, kg.

The significance of the difference between groups was assessed using one-way analysis of variance (ANOVA) and the Tukey-Kramer multiple comparisons test [22] as a post-hoc testing tool. The distribution of sample data for normality was verified according to the Kolmogorov-Smirnov criterion [23]. If the data distribution significantly differed from normal, the non-parametric Mann-Whitney U-test was used [24]. Differences between groups were considered significant at $p < 0.05$.

Results and Discussion

The initial number of hens in Group 1, as presented in Table 2, was considerably smaller than in Groups 2 and 3 due to their density of 23 heads per 1 m² of the floor area of the cage per the requirements of VNTP-APK-04.05 [5]. The number of hens of Group 1 in each cage with an area of 0.392 m² at the beginning of the experiment was 9 heads. The planned densification of hens of Group 2 up to 26 heads/m² was achieved by placing 10 heads in similar cages. By placing 11 chickens in cages, their further density was achieved, up to 28 heads/m² (Group 3). As a result of the mentioned compaction, 30,912 more hens were planted in the Group 2, and in Group 3 even more – 61,824 heads. Notably, if the hens of Group 1 (control) were placed according to the density per the recommendations of the developer of the “Hy-Line W-36” cross [4], namely 13-20 heads/m², then their number in each cage would vary within 5-8 heads, i.e., there would be no more than 8 heads, and in a group (poultry house), respectively – no more than 247,296 heads, or 30,912 heads less.

Table 2. Productivity of hens depending on the density

Feature	Laying hen group			Requirements
	1 (control)	2	3	
Placed chickens, heads	278,208	309,120	340,032	
Density, head/m ²	23	26	28	22-25 ¹ 13-20 ²
Died and culled, heads	24,202	27,512	39,444	
Hens at the end of the experiment, heads	254,004	281,608	300,588	
Livestock safety, %	91.3±0.05	91.1±0.05 [*]	88.4±0.10 [*]	96.9
Eggs obtained:				
– total in the group (poultry house), pcs.	64,377,331	68,253,696	77,255,270	263.9-271.9
– per 1 m ² of birdhouse area, pcs.	26,135	27,708	31,363	
– per initial laying hen, pcs./head	231.4±0.23	220.8±0.09 [*]	227.2±0.47 [*]	
Efficiency coefficient production of eggs, conditional units	19.7±0.07	19.1±0.07 [*]	19.2±0.07 [*]	
Live weight of laying hens, kg				
– at 52 weeks of age	1,524±0.17	1,523±0.28 [*]	1,448±0.21 [*]	1,550-1,610
– at 62 weeks of age	1,531±0.12	1,536±0.52 [*]	1,496±0.67 [*]	1,550-1,610
Egg mass, g				
– at 52 weeks of age	63.7±0.04	64.2±0.01	65.0±0.03 [*]	62.5
– at 62 weeks of age	65.7±0.02	66.6±0.01 [*]	65.9±0.04 [*]	63.0

Note: ¹ – density of hens per the requirements of Ukrainian standards [5]; ² – per the recommendations of the developer of the chicken cross [4]; ^{*}p<0.05 – in comparison with Group 1 (control)

The conservation of chickens in Group 1 at the end of the experiment was 91.3%, i.e., it was 5.6% less than the normative level for this cross (96.9%) under the conditions of their keeping at a density of no more than 13-20 heads/m² [4]. The factual losses of laying hens (killed and culled) in Group 1 amounted to 24,202 heads, and upon placing according to the requirements of the cross developer, there would have been no more than 7,666 heads. This difference of 16,536 heads is probably a concrete consequence of keeping them at a density per Ukrainian standards [5], which is slightly higher than recommended by the developer of the cross [4]. In Group 2, and especially in the Group 3, the losses of laying hens were even greater than in Group 1 due to their respective over-densification.

Cross-bred hens “Hy-Line W-36”, according to the characteristics of the cross [4], can lay no less than 262.2 eggs per initial laying hen in 62 weeks of life, but in case of keeping according to the density recommended by its developer – 13-20 heads/m². As the experimental data shows (Table 2), keeping hens in Group 1 at a density of 23 heads/m² led to a decrease in egg production by 30.8 eggs (13.3%), namely to 231.4 eggs/head. Increasing the density of housing to 26 heads/m² (group 2) led to a decrease in egg production by another 10.6 eggs (to 220.8 eggs/head). Further densification of hens to 28 heads/m² (Group 3) did not lead to a corresponding decrease in their laying capacity. In the hens of this group, the laying rate was 227.2 eggs per head, i.e., it was 6.4 eggs higher than in Group 2. It was possible to find out the reason for this as a result of determining the factual density of keeping hens of Group 3, considering their current conservation. It was determined that due to the low level of conservation (88.4%), the initial

number of hens from 11 heads in each cage decreased to 9.7 heads at the end of the experiment. The density of their keeping decreased, respectively, from 28 to 24.7 heads/m². In fact, it decreased to 24.7 heads/m² much earlier, during the first 10 weeks of the experiment. That is, most of the 39,444 laying hens lost died or were culled during the first 10 weeks of the 43-week study period. Therefore, laying hens that remained alive and healthy were kept for another 33 weeks of the experiment at a density of no more than 25 heads/m², which meets the requirements of the norms [5]. The density of chickens of Group 2 at this time, as shown by similar calculations, was 26.0 heads/m².

Notably, at the beginning of the experiment, 30,912 (11.1%) and 61,824 (22.2%) more laying hens were placed in the same area of birdhouses in Groups 2 and 3 than in Group 1 due to their certain compaction (to 26-28 heads/m²). As a result, in Groups 2 and 3, more eggs were obtained in general and per 1 m² of the poultry house area, even despite a substantial (p<0.001) decrease in the level of laying ability of hens. In Group 2, an added 1,573 eggs were obtained from 1 m² of the poultry house area, in Group 3 – 5,228 eggs, but at a slightly lower level of the coefficient of efficiency of their production than in the control (Table 2). Furthermore, compared to control Group 1, 3,310 and 15,242 more laying hens were lost in these two experimental groups. Their live weight in case of prompt slaughter for meat would be 5,130 and 23,625 kg, respectively. Therefore, increasing the density of keeping Hy-Line W-36 cross hens in cages to 26-28 heads/m² ensures obtaining a slightly larger number of edible eggs from 1 m² of technological areas, but at the expense of reducing the efficiency of their production and added losses of laying hens.

Upon comparing the curve (Fig. 1) of the factual and normative intensity of laying hens, the current level of compliance with the norm regarding its growth, duration of retention at the peak and decline is usually judged to identify violations of the technological process of egg production and their prompt elimination. The laying intensity of Hy-Line W-36 cross-bred hens should be at least 50% on the 20th week of their life, 90% on the 22nd-23rd, and 95-96% on the 24th-25th. This peak level should

last 10-12 weeks and only then gradually decline to 86% at 62 weeks of their life. According to the given curves (Fig. 1), the laying of hens of all 3 groups was started when they reached 19 weeks of age, i.e., with a delay of 1 week according to the technological map-graph of the farm. Its intensity in hens of Groups 1 and 3 increased faster than in Group 2. They reached 50% of its intensity level at 22 weeks of age, and hens of Group 2 – at 24 weeks of age.

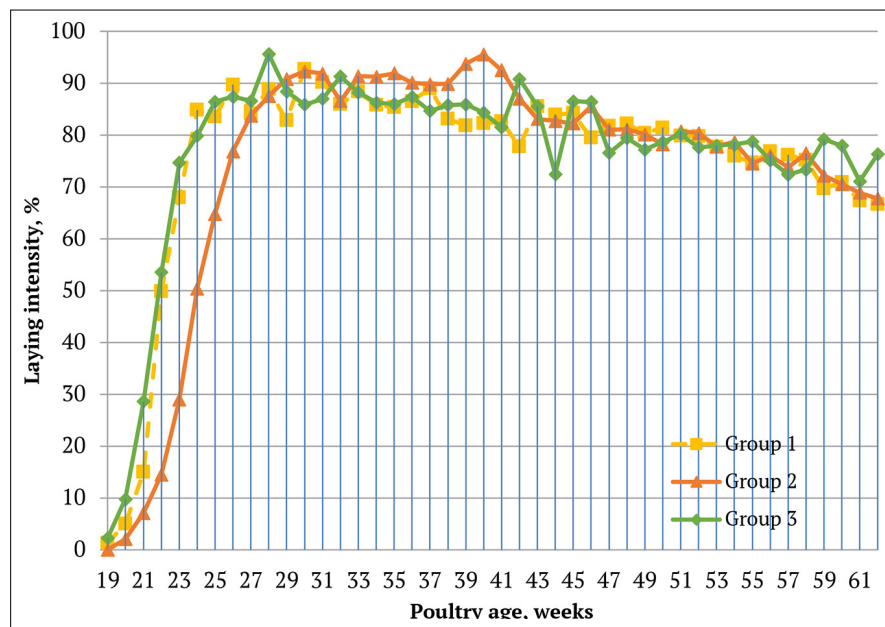


Figure 1. Curve of egg production intensity of hens

Hens of group 1 reached 90% of the laying rate at 24 weeks of age, the peak (92%) at 29-30 weeks of age (with some fluctuations), and at 62 weeks of age it decreased to 67%. Chickens of Group 2 reached 90% of the level at 29 weeks of age, reached the normative peak (96%), but only at the 40th week of life. Laying hens of Group 3 reached the normative peak level a little earlier, at 28 weeks of age, but it turned out to be short-lived. At 62 weeks of age, they exceeded their counterparts from other groups in terms of the intensity of pregnancy. Therefore, the configurations of the intensity curves of laying hens of all groups do not coincide with the normative ones from the beginning to the end of the experiment. This indicates a relatively uniform impact, i.e., without a cumulative effect, on this trait of a possible chronic stressor throughout the entire 43-week observation period.

The egg mass (Table 2) in hens of all groups met the regulatory requirements [4], and the live weight turned out to be somewhat lower. In laying hens of Group 3, this may be due to a lower provision of their feeding front during the first 10 weeks of the experiment.

The increase in the production of edible eggs is achieved by the majority of poultry complexes, as already mentioned above, not by the construction of new farms or poultry houses, but by the replacement of 1-3-tiered cage batteries of outdated structures in the existing premises with new 6-12-tiered ones. By replacing 3-tiered batteries with 12-tiered ones, the number of seats in the poultry house

with an area of 2463.3 m² increases from 69.6 thousand to 278.2 thousand, i.e., 4 times. Accordingly, the number of eggs obtained per year in the poultry house as a whole and per 1 m² of its area also increases by 4 times (from 9.6 to 38.4 thousand eggs). This is of particular importance for enterprises that lack free land for the construction of new poultry houses. But already modernised enterprises strive for further increase in the production of eggs due to high consumer demand for them in the Ukrainian and foreign markets. For this purpose, such enterprises resort to increasing the population of laying hens due to certain compaction of them [25]. Usually, if the poultry house is filled with the next batch of young chicks on the eve of the expected increase in demand for eggs, then they are planted in each cage by one or more heads exceeding the standard number. This leads to their compaction, the level of which depends on the number of additional laying hens planted. As evidenced by the results of the experiment, this fully applies to hens of the egg cross under study. Their over-compaction led to a certain decrease in carrying capacity and conservation inherent in chronic stress, which is consistent with the results obtained by other authors [13; 14; 26].

The effect of overcrowding of hens on their laying ability, conservation, and parameters of other characteristics (Table 2) was noticeable during the entire 43-week period of the experiment, i.e., until they reached 62 weeks of age. In particular, with an increase in the

housing density from 13-20 heads/m² (which is recommended for the Hy-Line W-36 cross) to 23 heads/m² (Group 1), the hens did not reach their typical laying capacity – 262.2 pcs./head in 62 weeks of life. It amounted to only 231.4 units/head, i.e., it was smaller by 11.7%. The data obtained are consistent with the results of many studies, which describe a decrease in egg production as a reaction of the bird's body to acute [27] and chronic stress [28], and the experimental administration of ACTH in hens confirmed atresia of follicles and a decrease in the weight of the oviduct [29]. Despite this, the specified increase in the density of keeping chickens allowed obtaining 1.6-5.2 thousand more eggs from 1 m² of the poultry house, but at the expense of a decrease in the efficiency of their production and added losses of laying hens. Other researchers obtained comparable results [30], who also noted a decrease in egg production per initial laying hen, as a reaction of the hens' body to the increased density of their housing. Furthermore, there are reports that the decrease in egg mass output is the result of the effect on the bird's body and other technological stressors, such as transportation, immobilisation, social isolation, etc. [31].

No influence of the researched housing density on egg weight was found. Its deviations from the normative level, which occasionally happen on farms, are probably the result of the action of food or other factors not investigated in this study.

Conclusions

1. The stocking density of laying hens of an industrial flock of white-egg crosses, which according to the requirements of VNTP-APK-04.05 should be an average of 23 heads/m², is not optimal for "Hy-Line W-36" cross hens if they are kept until they reach 62 weeks age in cages of 12-tier batteries.

2. Further densification of hens to 26-28 heads/m² leads to a decrease in egg-laying, conservation, and efficiency of production of edible eggs, but ensures obtaining a larger volume of them from the poultry house as a whole and from 1 m² of its area.

3. Densification of hens to 26-28 heads/m² by keeping them in cages of 12-tier batteries installed in poultry houses with an area of 2,463.3 m² made provision an added 3.9-12.9 million eggs for 43 weeks of laying, including 1.6-5.3 thousand per 1 m² of their total area, but with a certain decrease (from 19.7 units to 19.1-19.2 conditional units) of the efficiency factor of their production.

4. In the future, at the first stage, it is necessary to determine the level of profitability of the production of edible eggs and the economic feasibility of increasing their volume with the investigated compaction of laying hens.

5. At the second stage of research, it is worth comparing the efficiency of egg production for keeping laying hens in 12-tier cage batteries according to the density per the requirements of VNTP-APK-04.05 (20-25 eggs/m²) and under more comfortable conditions (13-20 eggs/m²) per the recommendations of the developer of the "Hy-Line W-36" cross. The results of these studies can be considered upon changing and amending the current norms of technological design in poultry farming regarding the density of hens of an industrial flock in cage batteries of 12-tier structures.

It is important to direct further research to the determination of the limit level of the density of laying hens in an industrial herd, exceeding which leads to the occurrence of obvious chronic or acute stress. Such a task is important from both theoretical and practical standpoint and can be performed in the future by keeping a limited number of laying hens in the vivarium.

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Несучість та збереженість курей промислового стада залежно від щільності їх посадки в кліткові батареї

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Анотація. Актуальність досліджень зумовлена браком експериментально обґрунтованих даних з оптимізації щільності утримання курей-несучок сучасних яєчних кросів в кліткових батареях нових багатоярусних конструкцій. Мета роботи полягала у визначенні впливу щільності утримання курей промислового стада в клітках 12-ярусних батарей на їх несучість та збереженість. Для цього несучок 3-х груп промислового стада кросу «Hy-Line W-36», утримували в окремих пташниках-аналогах, але за різної щільності. Зокрема, курей 1-ї групи посадили в клітки за щільністю 23 гол./м² згідно з нормами, а 2-ї та 3-ї груп – за 26 та 28 гол./м², відповідно, тобто за ущільнення на 13,0 % і 21,7 %. Згідно з характеристикою цього кросу несучість курей промислового стада має становити не менше ніж 262,2 яєць на початкову несучку за 62 тижні життя. Однак, у курей 1 групи вона становила 231,4 шт./гол., тобто була на 11,7 % на тлі нижчої на 5,1 % збереженості, яка за створення оптимальних паратипових умов існування відповідала б нормативному рівню (96,0 %). За підвищення щільності утримання до 26 гол./м² (2 група) та до 28 гол./м² (3 група) несучість курей становила 220,8 шт./гол. та 227,2 шт./гол. при збереженості 91,1 % та 88,4 %, відповідно. Підвищення щільності посадки курей 2-ї та 3-ї груп призвело до зниження несучості та збереженості, але забезпечило отримання більше продукції з 1 м² виробничих площ. Додатково отримано за 43 тижні продуктивного періоду 3,9–12,9 млн. яєць, у тому числі 1,6–5,3 тисяч у перерахунку на 1 м² їх площі. Таким чином, зазначене ущільнення може бути застосовано як технологічний прийом швидкого збільшення обсягів виробництва харчових яєць без будівництва нових чи реконструкції наявних ферм у разі виникнення додаткової потреби у даному продукті на внутрішньому чи зовнішньому ринках продовольства

Ключові слова: виробництво харчових яєць, продуктивність, кліткове устаткування, крива несучості, кури яєчних кросів, жива маса, умови утримання