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# Effectiveness Of A Comprehensive Insecticidal Program Against Tenebrionid Beetles Imago And Its Larvae In A Poultry Farm With Floor Management Of Broiler Chickens.

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**ABSTRACT**

Based on the quantitative analysis of the results obtained, it should be noted that the proposed program has a high deterrent effect on adult tenebrionid beetles due to first component, Solfak 5% also its second component, Baytsidal® larvicide 25%. This preparation affected the eggs and larvae of the beetle throughout the entire technological cycle, preventing them from transforming into adults, thus did not allow the tenebrionid beetle to grow its population. The results obtained in the course of scientific and production testing under the conditions of the poultry farming in Moscow region showed that the proposed comprehensive insecticidal program at various times after use provided a high intensefficacy against tenebrionid beetles imago (Solfak® 5%) - 94.9 - 100%, and its larvae (Baytsidal® 25%) - 97.8 - 100%. This indicates that Baytsidal® 25% larvicide is a strong element of this complex insecticidal program, which ensures a high stable efficiency throughout the entire broiler production cycle with the floor management.

**Keywords:** broiler chickens, tenebrionid beetle, insecticidal program, poultry houses, intensefficacy (IE).

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## INTRODUCTION

Among the large number of ectoparasites negatively affecting the productivity of the representatives of the chicken family (Galliformes), tenebrionid beetles , which are widely distributed in many poultry farms, should be especially noted. They are almost omnivorous, seriously destroying the agricultural products, and their larvae are most adapted for feeding in the poultry house. [1, 2, 5, 10, 16, 19].

Tenebrionid beetles (family Tenebrionidae) and their larvae actively eat the combined animal feed on the bedding and in the feeders, competing with the bird, thereby contributing to an increase in feed costs. The growing bird pecks up a large number of beetles and larvae from the bedding, which reduces the nutritional value of the diet and worsens fattening rates. More than **15%** of livestock show the growth retardation. The death of chickens as a result of blockage of goiter and intestines due to the absence of chitinase enzyme in birds, which allows digesting hard chitinous integuments of beetles and larvae, is often observed.

The research has established that the tenebrionid beetle serves as a carrier of many pathogenic microorganisms that cause infectious diseases, including viral diseases (leukemia, Marek and Gamboro diseases, Newcastle disease, avian influenza, avian smallpox, diseases caused by astro and reovirus, enterovirus, coronavirus infection turkeys), bacterial (caused by pathogens such as Salmonella spp., E. coli, Aspergillus spp., Staphylococcus spp., Campylobacter spp.), protozoal (coccidiosis); and it is an intermediate host for nematodes, cystodes. The beetle population can ensure the survival of pathogens between outbreaks of diseases, serve as a reservoir of infection and facilitate its transfer from one herd to another, which can be a real threat to human health [3, 5, 11-13, 18, 22].

Along with the biological threat posed by the beetle, it also causes significant mechanical damage to the premises, destroying sandwich panels, polystyrene foam, polyurethane foam, fiberglass, wooden structures and even concrete. In search of places for pupation, the larvae devour many kilometers in the insulation materials of the walls of the houses, breaking the insulation, which entails a significant increase in the cost of space heating in winter and cooling in summer. The research has shown that the cost of heating a room affected by the tenebrionid beetle is 67% higher than the cost of heating a similar, but insect-free house.

Most producers are faced with the complexity and sometimes the impossibility of effectively controlling the number of tenebrionid beetles in poultry premises. This is due to the fact that when appointing the insecticidal treatments they often do not take into account the peculiarities of the life of the tenebrionid beetle. Insecticides, adalticides, are widely used, but their mechanism of action is directed only against adults and does not work against beetle eggs and larvae. In addition, tenebrionid beetles become resistant to long-lasting insecticides, whose effectiveness decreases and does not always suit practitioners. [4, 6-9, 14, 15, 20, 21].

To successfully solve a problem, it is necessary to understand the connection between the life cycle of an insect and the production cycle of raising birds. The most massive accumulations of the beetle and its larvae are found in the bedding under the feeders and drinkers after 3-4 weeks after the bird is settled. From this moment until the slaughter of the bird, the tenebrionid beetle lays the maximum number of eggs, which are transformed into larvae and safely survive insecticidal treatments with adalyticides, carried out during the sanitery break down. Larvae form into adult individuals and lay even more eggs in subsequent poultry breeding cycles, thus increasing the population of tenebrionid beetles from one tour to another.

Purpose of our study was to test the effectiveness of a comprehensive insecticidal program against tenebrionid beetles imago and its larvae in a poultry farm with floor management of broiler chickens. The program is based on a combination of products with different mechanism of action - Solfak® adalticide 5% (against adults) and Baytsidal® 25% (against eggs and larvae).

## MATERIALS AND METHODS

The studies were conducted from July to September 2018 on the basis of CJSC Petelinskaya Poultry Plant of the Moscow Region. For the study 2 standard concrete poultry houses for broilers with chickens of 36.5 and 35.8 thousand heads, respectively were taken. The both poultry houses involved in testing were

characterized by similar parameters of the structure and microclimate; broiler chickens had the same feeding and housing conditions. Cracks in the concrete floors of both premises served as a shelter for tenebrionid beetles, their eggs and larvae.

Previously, two weeks before the end of the previous technological cycle and the beginning of the experiment, the background number of the beetle and its larvae in these poultry houses was determined.

**A trial poultry** house was treated consequentially with two insecticidal preparations — Adalticid Solfak® 5% (against adults) and Baytsidal® larvicide 25% (against eggs and larvae) during the general sanitary preparation of poultry facilities. Considering the high background number of the tenebrionid beetle, the treatment of an experienced poultry house with Solfak® 5% was carried out in "dirty" and "clean" modes.

Within the "dirty' mode Solkak® ME 5% was used outside the premises at a height of 2 m to prevent the land and air migration of adult beetles between poultry houses; indoors – at a height of 1 m immediately after removal of the bird, before removing the bedding, in order to destroy the adult beetles that are disturbed and scatter along the cracks.

The "clean" treatment with Solfak® 5% was carried out after disinfection and whitewashing inside the house to a height of 2 m, retreating 0.5 m from the floor.

The working solution of Solfak® 5% was applied using a Dezvac knapsack sprayer using nozzles with a flow rate of 0.8-1 l/min, at a pressure of 2-3 bar, at the rate of 100 ml of solution/m² on concrete walls, at a flow rate of 1 ml/m² of solution.

For destroying of eggs and larvae of the tenebrionid beetle, Baytsidal® 25% was used as a "clean" treatment of a trial poultry house with a dosage of 2 g/m² of the preparation on the floor, immediately after being treated with Solfak® 5%. The working solution was applied using the DUK unit. A large droplet spray was used at the rate of 300 ml/m² of concrete floor. 10-20 minutes later, after drying the floor, bedding was laid.

Taking into account the high background number of the tenebrionid beetle beetle and its larvae in the previous round, Baytsidal® 25% was additionally sprayed onto the bedding surface under the feeders and drinkers, since these places are most favorable for the active development of the larvae.

The reference poultry house was treated according to the method of gas burning of the floor and the lower part of the walls; insecticidal preparations are not used.

The results of the study in the trial and reference poultry houses were evaluated by the number of tenebrionid beetles and their larvae. To do this, they took 10 scrapings on 10x10 cm different parts of the floor every 7 days during the entire period of broiler cultivation. The scrapings were taken alongside with the veterinary service. The calculation was carried out in the conditions of the laboratory of the All-Russian Scientific Research Institute of Fundamental and Applied Parasitology of Animals and Plants n. a. K.I. Scryabin. The experimental data obtained during the study, both on the number of adult beetles and on their larvae, were subjected to statistical analysis according to the method of N.A. Plokhinsky (1978) and defined its significance. Statistical analysis of data was evaluated by using SAS/Stat (version №9 of the SAS System for Windows) software.

## RESULTS

The research results showed a significant initial number or background number of beetles and their larvae in scrapings taken on different parts of the floor two weeks before the end of the previous technological cycle and at the beginning of the study (table 1). The average number of adult beetles in one sample was 70.3 specimens in the trial poultry house, 67 in the reference; the average number of larvae, respectively, was 65.2 and 49.5 sp. Taking into account the indicators of two studied poultry houses, the average background number of imago beetles and larvae per 1 $m^2$ was 1260 pc. In the literature, the numbers of the tenebrionid beetle in poultry houses over 1000 pc./m² are noted as high [17, 23].

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**Table 1. The initial number of tenebrionid beetles and their larvae in the poultry houses two weeks before the completion of the technological cycle before the research**

| Poultry house, age of chickens | Average number in the 1st sample, pc. | | Average background amount in the house, pc. | | Average background for both poultry houses (per 1 $m^2$) | | |
|---|---|---|---|---|---|---|---|
| | beetles | larvae | beetles | larvae | beetles | larvae | total |
| **Trial, 22 days** | 70.3 | 65.2 | 703 | 652 | 686 | 574 | 1260 |
| **Reference, 24 days** | 67 | 49.5 | 670 | 495 | | | |
| **Statistical confidence**<br>**t*f* -**<br>**t*st*-**<br>**p> 0,05** | | | | | 0.14<br>2.1<br>**t*f*<t*st*** | 0.59<br>2.1<br>**t*f*<t*st*** | |

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**Table 2. The number of adult (imago) beetles in the 1st sample in poultry houses during the testing of the effectiveness of the Bayer insecticidal program with the floor broiler chickens management**

| Poultry houses | After treatments | In 1 week | In 2 week | In 3 week | In 4 week | In 5 week | Final |
|---|---|---|---|---|---|---|---|
| **Trial**, Solfak®, Baytsidal®, the average M±m | 2.8± 0.077 | 0.3±0.021 | 0.4±0.022 | 0 | 0 | 0 | 0 |
| **Reference,** the average M±m | 55.2± 7.14 | 43.5±11.6 | 49.0±10.91 | 32.5±6.27 | 21.4±3.44 | 24.0±1.38 | 29.1±2.81 |
| **Statistical confidence** **t*f*** - **t*st*-** **p< 0,05** | 7.3 2.1 **t*f*>t*st*** | 3.72 2.1 **t*f*>t*st*** | 4.45 2.1 **t*f*>t*st*** | | | | |

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**Table 3. The number of larvae in the 1st sample in poultry houses during the testing of the effectiveness of the Bayer insecticidal program with the floor broiler chickens management**

| Poultry houses | After treatments | In 1 week | In 2 week | In 3 week | In 4 week | In 5 week | Final |
|---|---|---|---|---|---|---|---|
| **Trial**, Solfak®, Baytsidal®, the average M±m | 0.41±0.019 | 0.23±0.012 | 0 | 0 | 0 | 0 | 0 |
| **Reference,** the average M±m | 18.9±3.77 | 23.1±2.44 | 25.3±2.27 | 72.8±18.75 | 97.9±16.13 | 72.5±21.19 | 49.3±13.88 |
| **Statistical confidence** **t*f*** - **t*st*-** **p< 0,05** | 4.9<br>2.1<br>**t*f*>t*st*** | 9.32<br>2.1<br>**t*f*>t*st*** | | | | | |

The studies during the technological cycle of the floor broiler management showed a high number of tenebrionid beetles despite the fact that within the preparation of poultry houses the insecticidal treatment was carried with the adalticidal preparations.

In order to evaluate the effectiveness of the Bayer integrated insecticidal program and determine the duration of action of the Solfak® drugs 5% (against imago beetles) and Baytsidal® 25% (against larvae), we monitored the tenebrionid beetle population. For this purpose, the dynamics of the number of tenebrionid beetles and its larvae in the trial and reference houses was investigated throughout the broiler growing cycle (table 2 and 3).

In the study of samples taken after the the tratment of the trial house with Solfak® ME 5%, a significant decrease in the number of adults was found compared to the background value. However, part of the beetles survived, hiding in the crevices and cracks in the floor. Their number in the average sample was 2.8 pc., in comparison with the background 70.3 pc. The reference house showed a high number of beetles in the average sample – 55.2 pc., which is not much less than the background indicator – 67 pc. (table 2).

2 weeks after settling the chickens in the trial house, adult beetles were found only in two samples out of ten, which was 0.4 pc in the average sample. The reference house showed — 49 pc.

After 3, 4, and 5 weeks, all samples taken from the trial poultry house during the study were free of adult beetles. In the reference house the tenebrionid beetles were present in each sample, their average number in one sample was 32.5-24 pc.

At the final inspection, before the completion of the broiler production cycle, all samples taken in the experimental poultry house were free from insects. It should be noted that a small number of adult beetles were observed when cleaning the bedding from an experienced poultry house after slaughtering the bird. The numerous shelters in the cracks of the floor contributed to their preservation. In the reference house the beetles were found in all samples in an amount from 18 to 45 pc., and their average number in one sample at the end of the tour was 29.1 pc.

The quantitative analysis of the data obtained during the testing of the Solfak® 5% adalticide showed high efficacy against the tenebrionid beetles imago during the entire broiler breeding period.

The average background number of larvae of the tenebrionid beetle two weeks before the experiment and the completion of the broiler growing cycle was 57.4 pc. (table 1).

After treating the entire surface of the floor with Baytsidal® 25% in an trial poultry house in ten samples only three larvae were found. A week after the settlement of the birds the larvae were found in only two samples. Later, after 2, 3, 4, 5 weeks after settlement of the broilers and in the final period before the slaughter of the birds, the beetle larvae were not found (table 3).

The situation was quite different in the reference house. At the same time in all 10 samples the larvae of beetles were found. The average number of larvae in one sample grew within each week. 4 weeks after sattlement of the broilers, the largest average number of larvae of beetles in one sample was found – 97.9 pc. from 39 to 156 pc. In the final study the number of larvae in the sample was from 12 to 134 pc., with an average of 49.3 pc.

The quantitative analysis of the data obtained during the testing of the larvicide Baytsidal® 25% showed high efficacy against the tenebrionid beetles larvae during the entire broiler breeding period.

According to the results of studies, the IE of the insecticidal program was calculated – a decrease in the intensity of invasion after the measures taken. **IE** was determined based on the percentage reduction in the number of adult beetles and their larvae at different times after treatment.

*IE of the insecticidal program against adult beetles* was **94.9%** after treatment and **100%** at the end of the growing cycle.

*IE of the insecticidal program against beetles larvae* was **97.8 %** after treatment and **100%** at the end of the growing cycle.

## DISCUSSIONS

We have tested the Bayer maximum integrated insecticidal program for systemic protection against the tenebrionid beetle. It is intended for use with a high number of insects (more than 1000 pc./m2), and in our case the average total indicator of adult beetles and their larvae was 1260 pc./m2. Other programs — optimal and minimum — are intended for use with an average (from 100 to 1000 pc./m²) numbers and low (up to 100 pc./m²) numbers of tenebrionid beetles.

The noted high IE of the used program against imago beetles was provided by its first component, Adalticide Solfak® 5%, since it was this drug that destroyed the absolute majority of adult tenebrionid beetles during the preparation period and ensured their further destruction during the entire broiler production cycle due to its prolonged action.

Based on the quantitative analysis of the results obtained, it should be noted that the proposed program has a high deterrent effect on adult tenebrionid beetles also due to its second component, Baytsidal® larvicide 25%. This preparation affected the eggs and larvae of the beetle throughout the entire technological cycle, preventing them from transforming into adults, thus did not allow the tenebrionid beetle to grow its population.

This indicates that Baytsidal® 25% larvicide is a strong element of this complex insecticidal program, which ensures a high stable efficiency throughout the entire broiler production cycle with the floor management.

## CONCLUSION

The results obtained in the course of scientific and production testing in conditions of CJSC Petelinskaya Poultry Farm of the Moscow Region showed that the proposed Bayer integrated insecticidal program at various times after its use is characterized by high IE and provided reliable systemic protection against the tenebrionid beetles imago IE 94.9-100%, as well as its larvae IE 97.8-100%.

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