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Regulation of Cotton Bollworm Quantity by Pheromone Traps

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Abstract: ***The issues of regulation of the number of cotton bollworm according to pheromone traps, which simplify the system for monitoring the development of the pest and make optimal decisions in the fight against them, are considered n this article. The effectiveness of the use of pheromone traps to determine the number of cotton bollworm was assessed, and on their basis, mathematical models were developed for a brief and long-term forecast of pest development.***

Keywords: quantity regulation, pheromone traps, mathematical models, cotton bollworm, monitoring system, forecast

1. Introduction

The reduction of losses of cotton harvest from the cotton bollworm plays an important role in monitoring their numbers and signaling terms to deal with them. Currently used methods for monitoring and recording the number of cotton bollworm (route surveys of crop protection units, the use of effective temperature sums in determining the timing of occurrence of the pests by light and others types of traps and etc.) is quite cumbersome [1 -3]. With their help, it is not always possible to determine the condition of the pest over large areas and make optimal decisions on their treatment. The use of pheromone traps in the regulation of the number of cotton bollworm will greatly simplify the monitoring system for the development of the pest and make optimal decisions in the fight against them [4] . In addition, the use of sex pheromones will optimize the timing and amount of application of biological agents to combat the main pest of the cotton bollworm.

Evaluating the effectiveness of using pheromone traps used to determine the number of cotton shovel shows that the accuracy of the predictions is not always sufficient [5]. This is due to the fact that when determining the size of the cotton bollworm using pheromone traps insufficiently use information about environmental factors. In this connection, studies on the development of special mathematical models, for example, in [6] , which allow to take into account the factors of the abiotic and biotic environment, with the aim of reducing the forecast error, are relevant.

2. Materials and methods of research

As the experience of modeling such processes, the main problems are the choice and minimizing complex informative signs of forecasts. Questions on the selection of significant factors using pattern recognition methods are given in [6, 7].

3. Results and discussion

The effectiveness of methods for predicting the dynamics of the number of pests of agricultural crops depends mainly on the system of accounting for source information and its processing algorithm. The accounting system of the initial information (in our case, the data of pheromone traps) represents a certain method of information retrieval. The algorithm for processing accounting information includes an algorithm for averaging information (in this case, data of pheromone traps from an account) and a mathematical model for predicting the number of pests.

Based on the foregoing, this article discusses the issues of accounting data in the synthesis of algorithms for processing information obtained from pheromone traps.

To develop a mathematical model of the intensity forecast of cotton bollworm egg laying, depending on the number of captured males and to use the data obtained from pheromone to pest [8] . Traps with sex pheromone exhibited in cotton fields for 3-5 days prior to the flight of butterflies at the rate of 1 to 2 hectares of a trap. Then one trap with cotton moth pheromone will be controlled in 2 0000 sq.m. of cotton field. If we keep in mind that the density of cotton plants in one hectare by 100,000 pcs., the cotton plants of 100 pcs (census of cotton bollworm taken out on 100 accounts of cotton plants) will engage in 20 sq.m area. It was established experimentally that 35-40% of male butterflies of a cotton moth are caught by one trap. In determining the intensity of the butterflies of the cotton moth, such biological indicators as the fecundity of one female and the number of eggs in one clutch are taken into account.

To calculate the number of egg clutches of a cotton moth butterfly per 100 plants ($_{Kk}$), you can use the formula:

$$TO_k = N / K_p \quad S$$

where N is the number of pest eggs per 1 hectare; K is the number of plants per hectare; S is the average number of eggs in one clutch.

In this case, the predicted number of pest eggs per 1 ha is calculated by the formula:

$$N = ½ K_c \quad S_p \text{ (one)}$$

where K_c is the number of captured males on average per 1 trap; S_p - The average fecundity of one female of the cotton moth.

Since the sex ratio of a cotton moth is 1: 1, the formulas proposed above can determine the expected number of pest eggs per 1 hectare of the cotton field. Using the above According to pheromone traps, the number of cotton scoops eggs per hectare was determined in the production formulas according to pheromone traps (short-term forecast).

To determine the average fecundity of one female cotton spatula (S_p) on cotton, a model was developed in the form of the following set of intermediate variables:

$S_p = -587.77 + 1.345 Y_{11} + 1.14 Y_{12} - 0.0009 Y_{11} Y_{12}$, (2)

Where

$Y_{11} = -23287.67 + 1194.68 X_p 81.98 X_m - 4.047 X_m X_p$;

$Y_{12} = 2155.81 - 356.21 X_k - 109.25 X_p + 27.578 X_k X_p$;

Here X_m is the mass of the pupae; X_p - the size of the pupae; X_k - culture (food), which the owner ate. In this case, the correlation coefficient is very high R = 0.94; and the approximation error was 14.5 eggs.

Then the expression (1) with the expression (2) takes the form:

$N = ½ K (-587.77 + 1.345 Y_{11} + 1.14 Y_{12} - 0.0009 Y_{11} Y_{12})$ (3)

where

$Y_{11} = -23287.67 + 1194.68 X_p 81.98 X_m - 4.047 X_m X_p$;

$Y_{12} = 2155.81 - 356.21 X_k - 109.25 X_p + 27.578 X_k X_p$;

4. Conclusions

This, the number of eggs of a cotton bollworm per hectare is determined using expression (3) , knowing the number of males caught on average per trap and the values of the mass and size of the pupae. The results obtained were tested in the practice of Andijan and Kashkadarya center crop protection. It should be noted that as a result of these studies, such urgent issues as the optimal placement of pheromone traps on cotton fields and the method for determining the number of eggs were solved.

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