AJPMHS GLOBAL RESEARCH NETWORK

AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 4, Issue 5, 2026 ISSN (E): 2993-2149

Cycades of The Family Cicadellidae, Genus Kyboasca Modern Pests of Cotton

Alevtina Kojevnikova
Tashkent State Agrarian University, Tashkent, Uzbekistan

Khashim Yakhyayev
Research Institute of Quarantine and Plant Protection Tashkent, Uzbekistan
E-mail: gnadezhda03@gmail.com

Abstract: The article presents the results of the study of cotton field pests from the Cicadellidae family, genus Kyboasca, species composition, harmfulness, nature of damage caused, natural enemies and recommends modern control measures. The issues of working out mathematical models of cicadas' development and spread, built based on the populations specifics, the nature of their reactions to environmental factors, which makes it possible to model and effectively manage them, are considered.

Keywords: family, genus, cotton, cicadas, pests, Cicadellidae, Kyboasca bipunctata Osh, harmfulness, natural enemies.

Introduction

In recent years, a special phytosanitary situation has developed in the Republic of Uzbekistan, associated with an increase in the area under grain crops in irrigated agriculture and changes in the system of farming agricultural crops, mainly cotton and grain [1].

Currently, protective measures developed and recommended by scientific institutions provide an effective control of a complex of harmful organisms. There are no harmful objects against which plant protection would be powerless.

The task is to apply correctly and organizationally the existing recommendations, protective and technical means. For all recommended protective equipment, the technology and tactics for their use have been developed [2].

The most important task of agriculture in Uzbekistan is to increase the production of high-quality cotton crops. However, it is necessary to take into account the negative impact of the reproduction of various types of harmful organisms [3], in particular, insects from the Cicadellidae family, genus *Kyboasca*. Every year the distribution area of species from this genus is expanding, the most dangerous of which is the pest cicada *Kyboasca bipunctata* Osh.

In general, cicadas are distributed differently in Uzbekistan, depending on the species. In the conditions of Uzbekistan, cicadas are found in a wide variety of biotopes. They prefer field crops, herbaceous communities, and are found in abundance on shrubs and trees. Cycads are abundant on their favorite cultivated and wild plants [4].

According to A.G. Kozhevnikova, 208 species of cicadas are existed in the northern part of Uzbekistan, 207 species in Zeravshan Valley, and 173 species in Southern Uzbekistan. In addition, according to G.K. Dubovsky, there are 236 species in Fergana Valley [5].

Table 1.
Species composition of cycads on agricultural plants in natural and historical cotton growing zones in Uzbekistan (Kojevnikova, 2023)

№	Crop Growing Zone	Number of species
1.	Northern Uzbekistan	208
2.	Zeravshan Valley	207
3.	Southern Uzbekistan	173
4.	Fergana Valley	236

Totally 72 species of cicadas were revealed in cotton fields in 2019-2023, of which 50 species damage various agricultural crops.

There are different types of cicadas inhabiting cotton fields, but not all are pests. Some species are neutral, their numbers do not reach the economic threshold of harmfulness, or they live on the weeds found among cotton fields, or in their surroundings. However, many species are carriers of viral diseases[6].

At the current stage of specialization and intensification of agriculture, in connection with the need for general improvement of the strategy and tactics of plant protection, the importance of forecasting the spread and development of agricultural crops pests, including cycads, has sharply increased[7].

The use of mathematical methods based on the specifics of populations and the nature of their reactions to environmental factors makes it possible to model the dynamics of cicada populations and effectively manage them.

The interests of agricultural production development require constant monitoring of pest control. The most promising and safe method is the biological method. Its use most rationally takes into account the need to preserve beneficial fauna. This method is also important because it solves the problem of not complete species destruction, but maintaining it at a constant, harmless level in terms of numbers in order to maintain balance in the biocenosis. Therefore, the identification and clarification of the species composition of cotton pests, determination of the harmfulness of the most dangerous species, study of natural enemies, mathematical modeling of the process of pest population dynamics and the ability to recommend modern control measures were the goals of the research[8].

Methods

The material for this work is based on 5 years research conducted in Uzbekistan. Collections, observations, experiments and records were carried out. Generally accepted and special methods were used.

Results and Discussion

Individuals of the cicada family Cicadellidae, genus *Kyboasca*, differ sharply from other representatives of this family in the nature of the elytra venation and the structure of the generative apparatus. They inhabit mainly on mesophilic herbaceous and woody-shrubby vegetation. In the conditions of Uzbekistan, these are slender cicadas, often with brown spots at the top of the forewings. The apical veins of the fore wings usually arise from the distal part of the medial vein[9]. The body color of cicadas, in our conditions, is green, but with alternating light and dark tones. The crown is almost rectangular. It is shorter than its width. Rounded at the front, slightly cut out at the back with a longitudinal line. The plane of the crown in profile is slightly higher than the pronotum. Simple eyes are located closer to the compound eyes. The antennae are relatively long and lie in the depressions under the eyes[10].

In total, 72 species of cicadas were found in cotton fields in 2018-2022, of which 50 species damage various agricultural crops.

Research conducted in natural-historical cotton-growing zones has shown that only 6 species of cicadas cause significant damage to cotton. Of these, 2 species are from Cicadellidae family -

Empoasca meridiana Zachv., *Kyboasca bipunctata* Osh.

These two species feed on the plant's cell sap, weaken it, cause plant depression and reduce yields by 10-15%. They are now found everywhere in the fields and are the most harmful. Studies have shown that these are polyphagous and highly mobile species. When damaged by *Kyboasca bipunctata* Osh., cotton leaves become discolored, curl and often fall off, sometimes becoming covered with brown spots along the veins[11].

Cicadas of Cicadellidae family, genus *Kyboasca*, like other insects, are attacked by natural enemies that reduce their numbers. We discovered parasites from the families Tromididae, Dryinidae, Dorilidae. Dryinidae were more effective in the conditions of Uzbekistan[12].

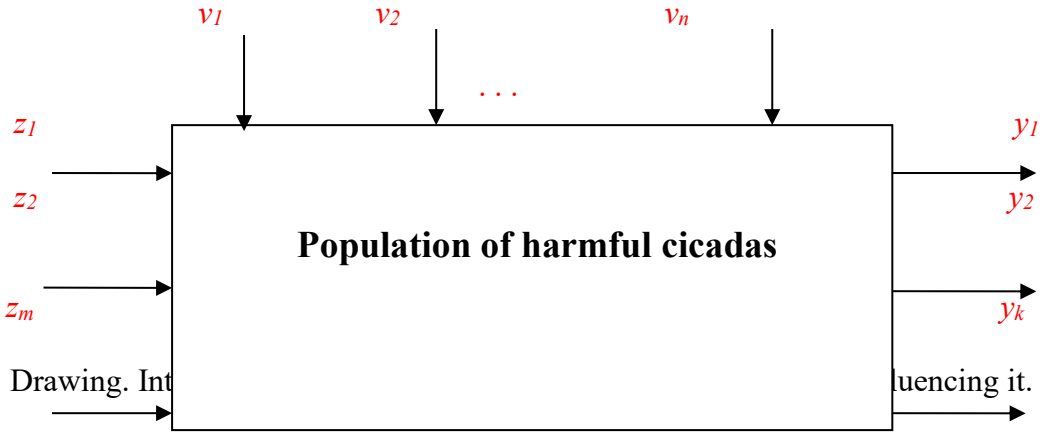
Mathematical methods for forecasting the dynamics of the cotton cicada pests population consist of using available data on the characteristics of the predicted object, processing these data using mathematical methods, obtaining a dependence linking these characteristics with time and calculating, using the found dependence of the studied object characteristics at a given point of time [13]. The population of cotton cicada pests, according to, can be considered as a certain process, shown in the figure. The summation of parameters $(V_1, V_2, \ldots, V_n)$ and $(Z_1, Z_2, \ldots, Z_m)$ forms the input of the research object and the summation $(Y_1, Y_2, \ldots, Yk)$ forms the output. Obviously, the inputs and outputs of an object can be considered as some multidimensional vectors in the parameter space. Thus, for the vector V the space has n dimensions, for the vector Z - m dimensions, and for the vector Y - k dimensions[14].

The output of an object is related to its inputs in a certain way, for example, by means of an operator F,

$$Y = F(V, Z) \qquad (1)$$

which characterizes the structure of the given object.

Finding the quantitative relationship between the parameters (1), i.e. the full disclosure of the operator F, constitutes the essence of the problem of the object under consideration. As a result of modeling, a mathematical model of this object is obtained[15].



Drawing. Int luencing it.

In expression (1), the set V forms (in ecological terms) a set of biotic factors, Z is a set of abiotic factors, and Y is a set of factors characterizing the pest population. These may include such indicators as the number (density) of pests, the size of agricultural crops areas infested with pests, the dates of pest appearance, etc.

Let us assume that in expression (1) the vectors Y, V, Z are accessible to observation and their components can be measured. Then, if the structure of the operator F is known, then the problem of mathematical modeling of the dynamics of agricultural pests population, which consists of establishing the influence of biotic and abiotic environmental factors on the dynamics of agricultural pests population, is reduced to finding an unknown vector of parameters $A = (a_1, a_2, \ldots, a_s)$, the components of which are quantities that depend on the factors V and Z*[16]*.

1-Figure. Imoga of *Kyboasca bipunctata* (with internet).

The solution to this problem allows us to move on to a range of problems associated with solving the problems of predicting the dynamics of the population of cotton cicada pests and developing optimal plans for controlling them.

Let us assume that for some ecological process the analytical form of expression (1) has been found, i.e. the values of vector A parameters have been determined. Let us assume that the obtained model, described by expression (1), is adequate to the studying process. Then the determination of the value Y_t at the output of the model of some future moment $t+1$ constitutes the essence of the forecasting problem for the vector Y.

Thus, expression (1) in general shows the relationship between the dynamics of cicada pests' population and the factors influencing it.

As mentioned above, the predicted parameters of the pest population (y_m) can be such characteristics as its number (density), the size of the infected areas of agricultural crops, the dates of pest appearance, etc., and their measures (factors of biotic and abiotic environment) are established by a specialist who knows the object of prediction well.

To identify the analytical form of expression (1), various identification methods are used. We will focus on the method of group accounting of arguments (MGAA). The purpose of MGAA is to obtain the result of a complete enumeration according to the selection criterion. MGAA belongs to a group of methods based on the mathematical processing of historical data and is intended to solve the so-called interpolation problems of technical cybernetics.

There are various MGAA algorithms, which differ from each other in the type of approximating function. One of the algorithms is the polynomial MGAA algorithms. These algorithms are used to implement multi-row selection when solving problems of finding an optimal model, given in the form of a power polynomial.

According to polynomial MGAA algorithms, the complete description of the object (1) is replaced by a certain set of so-called partial descriptions, which are functions of two arguments. In the first row of selection, particular descriptions look like:

$$Y_{1k} = f_k\,(X_{kj}\,,\, X_{kl})\ , \qquad (2)$$

in the second and subsequent rows:

$$Y_{ik} = f_k\,(Y_{i-1,k}\,,\, Y_{i-1,k+1}) \qquad (3)$$

As approximating functions f_k, polynomials of no higher than the second degree with respect to two arguments are used, on the first row of selection:

$$Y_{1k} = a_{1k}^{(0)} + a_{1k}^{(1)}X_{jk} + a_{1k}^{(2)}X_{lk} + a_{1k}^{(3)}X_{jk}X_{lk} + a_{1k}^{(4)}X_{jk}^2 + a_{1k}X_{lk}^2$$

on the second and subsequent rows:

$$Y_{ik} = a_{ik}^{(0)} + a_{ik}^{(1)}Y_{i-1,k} + a_{ik}^{(2)}Y_{i-1,l} + a_{ik}^{(3)}Y_{i-1,k}Y_{i-1,l} + a_{ik}^{(4)}Y_{i-1,k}^2 + a_{ik}^{(5)}Y_{i-1,l}^2$$

Here i is the number of selection rows, $i = 2,3,\ \ldots,\ N$;

k - number of particular descriptions, $k = 1,\ 2,\ \ldots,\ C_n^2$;

$$j = 1,\ 2,\ \ldots,\ N\text{-}1;\ \ l = j+1,\ j+2,\ \ldots,\ N$$

where N is the number of arguments.

The coefficients of partial descriptions are determined based on the training sequence (TS) data, for which the least squares method is used.

It should be noted that in order to obtain stable solutions, the existing data set is divided into training and testing sequences (TS).

From series to series of selection, with the help of threshold selections, from all particular descriptions (2) and (3) the most regular variables, called intermediate variables, are passed. With the increase in the complexity of the intermediate variables, the complexity of the model increases and at some point it will become equal to the complexity of the object, while the value of the self-selection criterion reaches its extreme value. One of the intermediate variables of the last row is selected as the final solution. A complete description of an object is obtained as a set of intermediate variables.

Based on this, the table shows the results of zoning the territories of the Andijan region. From the data in the table, it can be concluded that the forecasts developed for the Andijan district, which belongs to the first class, are also used in other districts belonging to this class.

Table 2.
Zoning of the territories of the Andijan region

№	Names of districts	District classes	Information weights of districts
1.	Andijan	1	0.961
2.	Asaka	1	0.915
3.	Baliqchi	2	0.890
4.	Bulokboshi	4	0.621
5.	Buzskiy	2	0.813
6.	Zhalakuduk	4	0.508
7.	Izboskan	2	0.810
8.	Kurgantepa	4	0.544
9.	Markhamat	1	0,909
10.	Oltinkul	1	0.971
11.	Pakhtaabad	3	0.702
12.	Ulugnar	2	0.872
13.	Shahrihans	3	0.796
14.	Khujaabad	3	0.785

Conclusions

Research has shown that 72 species of cicadas live in cotton fields and their surroundings, and 6 species of cicadas feed on and damage cotton plants directly, the reliable identification of which is based on the structure of the genital apparatus, according to modern taxonomy.

According to the latest data, cicadas are identified not only by morphological characteristics, but, most importantly, by the structure of the male genital apparatus.

The study and breeding of cicada parasites living on cotton plants make it possible to recommend the use of natural populations of natural entomophages, the most effective parasites from Dryinidae family, the infestation of which fluctuates by year and zone of Uzbekistan from 15 to 18%.

The development of mathematical models of cicadas' development and spread makes it possible to determine the optimal values of the pest and effectively manage them.

References

[1] Kozhevnikova A.G., Yahyaev Kh.K. Effective methods and means of protection grain crops from *Eurygaster integriceps* Put. in the republic of Uzbekistan // International Scientific Conference Ecological and Biological Well-Being of flora and Fauna EBWFF. – 2023. – Part 1. – P. 1–9.

[2] Mozaffarian, F., & Wilson, M. R. A checklist of the leafhoppers of Iran (Hemiptera: Auchenorrhyncha: Cicadellidae). *Zootaxa*, 4062(1), 1–63, 2016. doi:10.11646/zootaxa.4062.1.1.

[3] Zhang, B., & Webb, M. D. A checklist and key to the idiocerine leafhoppers (Hemiptera: Cicadellidae) of Hainan Island, with description of a new genus and new species. *Zootaxa*, 4576(3), 551–570, 2019. doi:10.11646/zootaxa.4576.3.10.
[4] Wang, Y., Dietrich, C. H., & Zhang, Y. Phylogeny and historical biogeography of leafhopper subfamily Evacanthinae (Hemiptera: Cicadellidae) based on morphological and molecular data. *Scientific Reports*, 7, 45387, 2017. doi:10.1038/srep45387.
[5] Webb, M. D. Species recognition in *Cicadulina* leafhoppers (Hemiptera: Cicadellidae), vectors of pathogens of Gramineae. *Bulletin of Entomological Research*, 77(4), 683–712, 1987. doi:10.1017/S0007485300012207.
[6] Knight, W. J. Leafhoppers of the grass-feeding genus *Balclutha* (Homoptera, Cicadellidae) in the Pacific region. *Journal of Natural History*, 21(5), 1173–1224, 1987. doi:10.1080/00222938700770731.
[7] Meng, Z. H., Yang, M. F., & Webb, M. D. Identity of the leafhopper *Kolla albescens*, with new synonymy (Hemiptera: Cicadellidae). *ZooKeys*, 420, 61–68, 2014. doi:10.3897/zookeys.420.6899.
[8] Zahniser, J. N., & Dietrich, C. H. A review of the tribes of Deltocephalinae (Hemiptera: Auchenorrhyncha: Cicadellidae). *European Journal of Taxonomy*, 45, 1–211, 2013. doi:10.5852/ejt.2013.45.
[9] Dietrich, C. H. Phylogeny of the leafhopper subfamily Evacanthinae with a review of Neotropical species and notes on related groups (Hemiptera: Membracoidea: Cicadellidae). *Systematic Entomology*, 29(4), 455–487, 2004. doi:10.1111/j.0307-6970.2004.00250.x.
[10] Yahyaev Kh.K., Abdullaeva Kh.Z., Musaeva G.M. Methods for selecting significant factors in forecasting and zoning territories // *Evropean Chemical Bulletin*. – 2023. – 12 (Special Issue 7). – P. 2164–2176.
[11] Kozhevnikova A.G. *Cicadas (Auchenorrhyncha) – pests of agricultural crops of Uzbekistan*. Diss… Doctor of Biological Sciences. – Tashkent, 2000. – P. 314.
[12] Dubovsky G.K. *Cicadas (Auchenorrhyncha) of Fergana Valley*. – Tashkent: Fan, 1966. – P. 57.
[13] Yakhyaev H.K., Kholmuradov E.A. *Automation of forecasting the development and spread of pests and diseases of agricultural crops*. – Tashkent: FAKK, 2005. – P. 169.
[14] Yahyaev Kh.K., Abdullaeva Kh.Z. Theoretical foundations for constructing mathematical models of development and distribution of crop pests // *International Scientific Journal Science and Innovation*. – Vol. 2. – Issue 2. – 2023. – P. 200–217.
[15] Dietrich, C. H. Keys to the families of Cicadomorpha and subfamilies and tribes of Cicadellidae (Hemiptera: Auchenorrhyncha). *Florida Entomologist*, 88(4), 502–517, 2005.
[16] Dietrich, C. H., & Pooley, C. D. Automated identification of leafhoppers (Homoptera: Cicadellidae: *Draeculacephala* Ball). *Annals of the Entomological Society of America*, 87(4), 412–423, 1994. doi:10.1093/aesa/87.4.412.