



IMPLEMENTATION OF "PEST-ENTOMOFAG" PROCEDURE IN BIOLOGICAL PROTECTION OF COTTON IN UZBEKISTAN

Yakhyaev Kh.K.¹, Abdullaeva Kh.Z.²

¹PhD in agricultural sciences, Uzbek Scientific Research Institute of Plants
Protection of Uzbekistan, Tashkent;
yahashim@mail.ru

²Doctoral student of Andizhan Agricultural Institute, Uzbekistan
xuriyat2686@mail.ru

ABSTRACT:

The problem of development of optimum plans of biological fabrics work for release of useful entomophages (trichogramma, bracon, lace wing) against the cotton pests (*Heliothis armigera*) for different zones with using the methods of modeling and programming has been examined.

The period of "owner's development" (*Heliothis armigera*) and optimum periods of release of useful entomophages in dependence on weather conditions of the year were defined on the basis of algorithms' working out.

Indexing terms/Keywords

Biological control against cotton pests; Trichogramma; optimal plans of control; *Heliothis armigera*; mathematical model; parasite.

Academic Discipline And Sub-Disciplines

Agriculture

SUBJECT CLASSIFICATION

Plants protection.

TYPE (METHOD/APPROACH)

Experimental; Mathematic modelling

INTRODUCTION

Practiced in the past decade, the pests control system environmentally and economically led to the serious problems associated with the negative impact on the environment and the emergence of pests resistance to protection plants, mainly due to massive use of chemicals (especially not sufficiently substantiated their implementation). Partly it even contributed directly or indirectly strengthen the harmfulness of certain types of pests and diseases and a growing dependence on the effectiveness of crop to control them.

In this regard, in recent years, it is becoming increasingly widespread biological method of pest control as the most satisfying to the principles of environmental protection.

MAIN PART

So to control sucking pests main position is the use of natural entomophages (*Trichogramma*, *Bracon*, lacewing, etc.). An important role is played by the increase in the number (density) of these beneficial insects through artificial breeding, seasonal colonization against their pests. To this goals, the country built and successfully operated biological laboratories and fabrics for the breeding and propagation of parasites (now their number exceeds 700 pcs.).

For the most efficient operation of these biological laboratories need to develop optimal plans for pest control, which will determine breeding norms of parasite (entomophagous), depending on the available forecast density of the pest. And the development of optimal control plans, being quite challenging, requires prior mathematical modeling of the dynamics of populations of agricultural pests.

Biological suppression of harmful pests has occupied today a constant predominating position in the concept of integrated suppression of pests. In certain cases for successful regulation of number of insects - pests any form of biological suppression of their populations is enough; in a number of other cases, suppression is often supplemented with any other method, and at last, in the third, it plays only an auxiliary role. Nevertheless, an effective implementation of biological agents became now a method to be considered and widely applied in all chances. In this connection, it is necessary to study the inter-specific ecological communications, which play an important role in vital systems of populations.

There are following biological methods of control against agricultural pests: breeding and reproduction of a carnivore (parasite) of the devouring certain pest for the purpose of suppression of agricultural pests reproduction; breeding of pathogenic microorganisms causing certain diseases of pests, leading to reduction of their number, etc. But among the above listed methods of control the most comprehensible is a method of breeding and reproduction of carnivores (parasites). So, for sucking pests' control the main position is occupied with application of natural entomophages



(trichogramma, bracon, lacewing, etc.). The big role-plays an increase in number (density) of these useful insects by artificial breeding and their seasonal colonization against pests. Thereto biological factories on breeding and reproduction of parasites have been built and successfully functioning.

It is necessary to develop optimal plans of control against agricultural pests to define the plan of release of parasites (entomophages) depending on available forecast of number (density) of the owner (pest) for the most effective work of these biological factories. And development of optimum plans of control, in turn, being a difficult problem enough, demands preliminary mathematical modeling of population dynamics of agricultural pests.

As it has been noted in [1], among biological control the most effective is a method of mass release of "entomophages" breed up in laboratory conditions (now the automated biological factories on manufacture of "parasites" and "carnivores" exist and successfully functioning. From that follows the problem of development of optimum work plans of these biological factories (terms and norms of "entomophages" release depending on seasonal conditions of a year. For example, against cotton worms the parasite of Trichogramma sort, parasitizing the eggs of this pest is successfully used. But the authors of article [2] consider that "parasite" of this sort has a very low search ability which prevents to become it the agent of biological control.

But according to Yu.N.Fadeev [2] these obstacles can be eliminated by applying "a flooding" method, at which a number of parasites is supported at high level by periodic mass releases of "parasite" in agrocoenosis. In this case the acceptability of this method is defined by purely economic reasons.

By their nature, the trichogramms infect eggs of the pest. Hence, a correct forecasting of terms of pests' mass ovipositions raises an efficiency of application of this kind of a parasite at pest control.

At realization of this problem in scientific work [3,4] the following assumptions have been made:

1) Owing to small period of trichogramms life, to be equal to 3-5 days, summands $f_1(R_1, V_1, t_1) - g_1(R_1^*, V_1^*, t_1^*)$

And $f_2(R_2, V_2, t_2) - g_2(R_2^*, V_2^*, t_2^*)$

as gain factors, have equated to zero;

2) Instead of frequency factor of occurrence of "parasite" and "owner" the factor of intensity of "owners" defeat by "parasites" is used. This indicator has been defined experimentally, from a parity of a share of "owners" to the infected individuals.

Then, an expression (3.32) from [3, 4] becomes:

$$\begin{aligned} N_1^k(t+1) &= N_1^k(t) - mN_1^k(t) N_2^k(t) \\ N_2^k(t+1) &= N_2^k(t) - mN_1^k(t) N_2^k(t) \end{aligned} \quad (3.1)$$

Thus, the problem was reduced to finding of such optimum values of $N_2^k(t)$ from (3.1) to satisfy restrictions system of (3.33) and providing a minimum of functional (3.34) of [3].

It is established that the intensity factor (m) of owners' defeats by the parasites, defined in laboratory conditions, gives the big errors in field conditions. As m really, directly depends on a number of pests.

Hypothesis: If S - number of infected eggs of victims then the intensity of owners' defeat by parasites is equal to $m = S : N_1$

On the basis of this hypothesis and according to expression (3.33) from [3] it is possible to write down form:

$$M = (e^{aN_2} - 1) : e^{aN_2} \quad (3.2)$$

Where: a - the search area (an average area which a parasite searches in a current of its life). The search area depends on search ability of a parasite and is defined under the field data or in laboratory conditions. Then expression (3.1) taking into account (3.2) will become:

$$\begin{aligned} N_1^k(t+1) &= N_1^k(t) - [e^{aN_2}(t) - 1] : e^{aN_2}(t) N_1^k(t) N_2^k(t) \\ N_2^k(t+1) &= N_2^k(t) - [e^{aN_2}(t) - 1] : e^{aN_2}(t) N_1^k(t) N_2^k(t) \end{aligned} \quad (3.3)$$

On the basis of (3.3) and with application of casual search method the optimum norms of release of a parasite (trichogramma) at the set prognostic values of the owner at $a = 0,01$ are defined. The results of calculation are resulted in Table 1. It is visible from Table 1 that at owner's presence in the field, the certain quantity of trichogramma is necessary. The more the owners number, the lower the quantity of parasites norm released by biological factory on 100 cotton plants. It allows concluding that on the basis of such calculations scheduling it is possible to plan biological factories' work on operating time of a biomaterial depending on owners' number in concrete economic year for concrete region of cotton growing.



Table 1. Norms of trichogramma release at given values of cotton dustpan

№	Number of the "owner" on 100 plants, in pieces	Optimum values of a parasite produced by bio-factory	
		Piece	Gramm
1.	7.0	158221.0	1,58
2.	7.5	158010.0	1,58
3.	8.0	152930.0	1,53
4.	8.5	152448.0	1,52
5.	9.0	150025.0	1,50
6.	9.5	147842.0	1,48
7.	10.0	146200.0	1,46
8.	10.5	145830.0	1,46
9.	11.0	143990.0	1,44
10.	11.5	142650.0	1,42
11.	12.0	141100.0	1,41

Table 2. Development of cotton dustpan and optimum periods of the undertaking out of biological protection (The first cotton generation, 2014)

Regions, areas	Development terms (day, month)				Release terms of entomophages (day, month)		
	Egg-laying	Caterpillars of 2nd age	Caterpillars of 4th age	Caterpillars of 6th age	Trichogramm	Lacewing	Bracon
Namangan region							
Pap	On June, 7th	On June, 13th	On June, 19th	On June, 24th	On June, 6-8th	On June, 7,13th	On June 19,24th
Uchkurgan	On June, 9th	On June, 15th	On June, 20th	On June, 25th	On June, 8-10th	On June, 9,15th	On June, 20,25th
Kashkadarya region							
Koson	On June, 3rd	On June, 9th	On June, 15th	On June, 20th	On June, 2-4nd	3, on June, 9th	On June, 15,20th
Nishan	On June, 2nd	On June, 8th	On June, 14th	On June, 19th	On June, 1-3st	2, on June, 8th	On June, 14,19th
Khorezm region							
Urgench	On June, 3rd	On June, 9th	On June, 14th	On June, 19th	On June, 2-4nd	3, on June, 9th	On June, 14,19th
Shavat	On June, 2nd	On June, 8th	On June, 13th	On June, 18th	On June, 1-3st	2, on June, 8th	On June, 13,18th

CONCLUSIONS

Thus, for definition of optimum terms of basic cotton pests' occurrence (cotton worms and winter cotton warms), depending on mean annual and real data for different zones of cotton growing in the Republic, the mathematical models and their algorithms are developed. On the basis of these algorithms the program of definition of terms of cotton worms and winter cotton warms' occurrence is made and introduced in practical activities of Plant protection Centers of Kashkadarya, Khorezm and Namangan regions. The research results are shown in Table 2. According to Table 2, it is visible that except the terms of cotton worms' development, the optimum terms of release of useful entomophages such as trichogramma, lacewing and bracon are revealed.



REFERENCES

1. Tadzhibaeva K., Yakhyaev Kh.K. Mathematical models of definition of optimum plans of biological factories works //Questions RASM. - Tashkent.: RISO AS UzSSR. 1985.-ed.38, p.80-87.
2. Fadeev Yu.N. Integrated control and management of harmful organisms population // Plant Protection.1979. №1, p.18-19.
3. Yakhyaev Kh.K. Development of scientific bases of forecasting automation and management of harmful objects of agricultural crops. -Diss. of PhD of agricultural sciences. – Tashkent. 1994, p.286.
4. Yakhyaev Kh.K., Rozet I.G. Reference modes and optimizing relation of ecological interaction of trihogramma-cotton worm// Cybernetics problems. Tashkent: RISO AS UzSSR 1984. ed. 128, p.29-36.

Author' biography with Photo



Yakhyaev Khashim Kasimovich

PhD in agricultural sciences, senior researcher.

Was born in 03/10/1950. Graduated in 1972 Tashkent state pedagogical institute with specialty Mathematics.

1972-1987 – worked as a researcher in Cybernetics Institute of Academy of sciences of Uzbekistan.

1987-2007 – head of laboratory in Uzbek Scientific Research Institute of Plants Protection of Uzbekistan.

From 2007 - Vice-director of Uzbek Scientific Research Institute of Plants Protection of Uzbekistan, Tashkent.



Abdullaeva Khuriyatxon Zafarbekovna

Doctoral student of Andizhan Agricultural Institute, Uzbekistan

Was born in 26/01/1986. Graduated in 2006 Andizhan state university with specialty Zoology.

2006-2007 – teacher of biology in special school #35 of Andizhan

2011-2013 – teacher of biology in Andizhan pedagogical college

From 2013 - Doctoral student of Andizhan Agricultural Institute, Uzbekistan