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SUITABLE INSECTICIDE FOR INTEGRATED PEST MANAGEMENT

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ABSTRACT
The article presents the results of testing the oxadiazine insecticide Avaunt with the active substance indoxacarb against the cotton bollworm on cotton and the mulberry moth on mulberries. In all experiments, high efficiency against caterpillars of all ages was obtained, which greatly distinguishes it from other preparations - larvicides. Depending on the objects, the consumption rates of the preparation can be in the range from 0.3 to 0.45 l / ha. The preparation is practically non-toxic for entomophages - trichogramma, bracon and lacewing, which is especially valuable in integrated plant protection programs.
KEYWORDS: *Cotton, tomato, insecticide, avaunt, cotton bollworm, mulberry moth, entomophages, efficiency.*

INTRODUCTION

Applied entomology has received an excellent preparation – the insecticide Avaunt, intended to combat the caterpillars of harmful butterflies. The preparation was synthesized and offered to the market by DuPont several years ago. By decision of the State Chemical Commission of the Republic of Uzbekistan, the insecticide Avaunt in the form of 15% k.s. underwent a comprehensive agrotoxicological assessment at the Uzbek Research Institute of Plant Protection (URIPP) after 2000.

Awaunt is a new generation insecticide: it is from a new class of chemical compounds - oxadiazines, has no analogues, has a unique mechanism of action on the insect organism. This provides it with high biological efficiency at low consumption rates and prevents (in the near future) the selection of group or cross-resistance of insects to this preparation.

Avaunt is an insecticide with contact and intestinal action. It does not have a systemic effect, but can penetrate deep into the tissue (deep or translaminar action). This property is especially evident when destroying cutworm eggs - the preparation is able to penetrate the egg shell and destroy the caterpillar embryo. Already formed caterpillars hatch, but after leaving the egg, they usually eat the shell. And this already causes intestinal poisoning of the young organism. So, Avaunt is an ovicide and larvicide, effective against all ages of caterpillars. Avaunt has been studied as a possible insecticide against the most dangerous pest of cotton in Uzbekistan - the cotton bollworm - *Helicoverpa armigera* Hbn. (Fig. 1) and a pest that has spread relatively recently in our country - the mulberry moth - *Diaphania pyloalus* Walker. (Fig. 2) on mulberries (*Morus alba* L.).

MATERIALS AND METHODS

The research was conducted in the Tashkent, Khorezm, Namangan, Andijan and Fergana regions. Agrotoxicological studies were carried out according to the "Methodological guidelines" ... (2004) and Sh.T. Khodjaev (2020). Biological effectiveness was derived using the Abbott formula (1925), which provides for a correction for control. The study of the danger of Avaunt and other insecticides on entomophages was carried out using the improved method of M. Golyshin et al. (1984), when experimental insects are offered leaves from treated plants every 24 hours.

RESULTS AND DISCUSSION

Based on the results of experiments conducted in various regions, a conclusion was made about the high biological efficiency of the insecticide Avaunt against cotton bollworm at a level of 75-100% at consumption rates of 0.4-0.45 l/ha, which is 17-30% higher than the standards: cypermethrin, esfenvalerate, betacyfluthrin. Based on these results, the State Chemical Commission of the Republic of Uzbekistan included the drug Avaunt in the List of pesticides recommended for use in Uzbekistan.

In the following 2013-2014 years, zonal demonstration tests of the insecticide Avaunt were conducted. In one of them, conducted in the Khorezm region, the treatment was carried out using a tractor sprayer OVH-28 (300 l / ha) on June 26. The results showed

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that within 20 days after treatment, Avaunt at a consumption rate of 0.45 l / ha showed high biological efficiency at the level of 79-100%. In the reference version - betacifluthrin (0.8 l / ha), the efficiency was lower (61-76%). The same results were obtained in experiments conducted in 2016-2018 in the Baghdad district of the Fergana region, the Pap district of the Namangan and the Balikchi district of the Andijan regions. Thus, it is a fact that Avaunt at a consumption rate of 0.4-0.45 l/ha is currently one of the best insecticides recommended against this pest.

As is known, the spread of a relatively new pest – the mulberry moth – is of particular concern to plant protection specialists and silkworm breeders in the republic (Fig. 2).

Figure 1. Cotton bollworm as a pest of agricultural crops.

Damage caused by bollworm caterpillars: 1 – to cotton bolls; 2 – to corn kernels; 3 – tomato fruits; 4 – to wheat ears; 5 – to sunflower heads; 6 – the process of treating cotton fields with the drug Avaunt; 7 – all ages of bollworm caterpillars die.

The pest turned out to be a monophage and, fortunately, does not damage anything except mulberry. High ecological plasticity and great life potential of the species allow it to spread quickly throughout the republic. Due to the lack of significant biological resistance in the new area, the reproduction potential of the species is very high and so far it can only be contained by chemical treatments. The caterpillars of the mulberry moth have a specific way of protecting themselves from enemies by folding the edges of the leaf where it feeds. This in turn complicates the fight against it. Insecticides with deep or intraplant action are required. Preparations with ovicidal action should be tested. Avaunt meets these requirements. Indeed, testing of this preparation in vegetation in 2013-2017 showed that Avaunt has unique capabilities to combat this pest to protect mulberries. The guarantee of success is the selection of optimal scientifically substantiated terms of treatments - during the period of mass egg-laying and hatching of caterpillars. Treatment of mulberry in these conditions allows to achieve efficiency of up to 99% at the rate of 0.3 l/ha. In conditions of violation of these requirements - in the presence of older caterpillars, the effect of Avaunt is achieved at an increased rate of consumption - 0.4 l/ha. Thus, Avaunt has found successful application here too. It is possible that Avaunt can be used against other objects, for example, against leaf rollers (Tortricidae) in pome orchards, or against apricot thick-legged moth (*Eurytoma samsonovi* Vass.) on stone fruits, etc. It is important to establish scientifically substantiated terms of treatments.

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Figure 2. Mulberry moth and effective protection against them:
1 – pest moths in pheromone traps, 2 – older caterpillars, scaling and mining of leaves, 3 – wrapping the edges of infected leaves, 4 – tractor treatment of infected trees using special attachments (200-300 l/ha of working fluid), 5 – manual treatment using motor sprayers (250-350 l/ha), 6 – all ages of pest caterpillars may die.

A great advantage of the insecticide Avaunt is its low toxicity for most entomophages. The reason for this property of the preparation is probably hidden in the specificity of its mechanism of action, which has a distinctive (selective) effect on butterfly caterpillars. To study this issue, we conducted laboratory and field experiments in 2001 and 2005. Using a special technique, we studied the acute and residual toxicity of Avaunt in the maximum recommended consumption rates on the imago of *Trichogramma pintoi*, *Bracon hebetor* and *Scolotrips acarifagus*; on the imago and pupae of *Encarsia formosa*; and the imago, eggs and larvae of lacewings (Chrysopidae).

The main objects widely used in Uzbekistan to combat cotton bollworm and developed in biolaboratories and biofactories are: trichogramma (12 species in total) and bracon. Therefore, it is very important to know the acute and residual toxicity of preparations for these objects. From the results of our studies, it was clear that Avaunt in all tested concentrations has some acute toxicity for trichogramma imago (see table). But already 2 days after treatment, even at the highest consumption rate (0.45 l/ha), it becomes safe for this entomophage. In the standards: cypermethrin and zetamethrin, this occurs only on the 15th day.

Table
Acute and residual toxicity of the insecticide Avaunt for entomophages and safe periods of their release after application of the preparation

№	The most widespread entomophages	At the rate of 0.4 l/ha, toxicity for:		Acceptable release dates (days after return)
		imago	other phases	
1.	*Trichogramma pintoi*	toxic for 1 day	non-toxic	2
2.	*Bracon hebetor*	1 day	non-toxic	2
3.	*Scolothrips acarifagus*	non-toxic	non-toxic	without restrictions
4.	*Encarsia formosa*	1 day	non-toxic	2
5.	*Chrysopa carnea*	non-toxic	non-toxic	without restrictions

For the imago of the bracon, Avaunt also turned out to be toxic in the first day after spraying (mortality 55-84%), but this activity passed 2 days after treatment, unlike the reference preparations, the activity of which lasted more than 8 and 6 days, respectively.

During cotton treatments, there may be various entomophages on the site, including an effective acariphage - a predatory mite-eating thrips (*Scolothrips acariphagus*). A study of this effect showed that the insecticide Avaunt is completely harmless to this insect.

On the day of treatment (after 1 hour), Avaunt turned out to be toxic for the imago of encarsia (*Encarsia formosa*) - an active endoparasite of whiteflies. But on the 2nd day, their toxicity dropped sharply to a safe level. For the “pupae” (mummified whitefly

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larvae), Avaunt turned out to be absolutely safe, just like the specific aleurodocid admiral (pyriproxyfen) and better than cymbusch-cypermethrin (42% mortality).

There are more than 13 species of lacewings in Uzbekistan, but the most common is *Chrysopa carnea*. A study of the toxicity of Avaunt for the imago, larvae and eggs of this predator showed that the drug is completely safe for individual phases of this insect, unlike cypermethrin and zetamethrin.

CONCLUSION

The insecticide Avaunt is an effective means of combating the cotton bollworm (0.4-0.45 l/ha) on cotton and the mulberry moth (0.3-0.4 l/ha) on mulberry.

Possessing unique capabilities of a gentle effect on the main types of entomophages of agrobiocenoses, Avaunt has taken a worthy place in integrated systems for protecting various crops from harmful organisms and continues to amaze with its capabilities.

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