

FOREST PROTECTION AND LANDSCAPING

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ASSESSING OF THE BIOLOGICAL EFFECTIVENESS OF THE BIOLOGICAL PREPARATION AKTOFIT APPROVED FOR USE IN THE FSC-CERTIFIED FORESTRIES

Use of all registered in the "State Register ..." insecticides except Aktara, WDG was banned in the FSC-certified forest enterprises of the Republic of Belarus since September 2015. Registration trials of a biological product Aktofit 0.2%, CE for protection of harvested timber from spruce stems pests, as well as against *Aradus cinnamomeus* on the pine stands were conducted in field conditions. In applying the drug Aktofit 0.2%, CE mortality of parental generation of bark beetles after treatment at a concentration of 0.4 and 0.5% on third day was 80.9 and 86.6%, and on the seventh day – 82.2 and 89.9%, respectively. In tests on pine stands insecticide Aktofit 0.2%, CE showed a fairly high efficiency against *A. cinnamomeus* Panz. The use of this preparation to the flow rate of 0.5 and 0.6 l/ha provided the biological effectiveness on the seventh day of 68.9 and 73.4% respectively, which is comparable with the level of the model chemical insecticide Tanrek, WDC (0.5 l/ha) recommended for use in forest stands. Application of biological products is not contrary to FSC policy that makes it possible to use Aktofit in the forestry.

Key words: biological preparation, stem pests, bark beetle, pests of forest stands, *Aradus cinnamomeus*, concentration, flow rate, biological efficiency.

Introduction. Correspondence of the system of management with the economic development and the adoption of environmentally friendly non-chemical methods of control of the number of pests and avoiding the use of chemical pesticides, where possible, is one of the criteria of the FSC Forest Stewardship Council certification. According to this criterion use pesticides Type 1A and 1B of the World Health Organization's classification, organochlorine pesticides, pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in the food chain causing side-effects, as well as any other pesticides banned in accordance with the international agreements is not allowed.

According to regulatory documents [1] harvested timber left for storage at loading points in the woods or at a distance of 0.5 km from the forest for a period longer than 10 days (at the spring-summer harvesting from 01.04 till 01.09) or at the moment when the period of flight of the main types of stem pests starts (at the autumn-winter harvesting), should be barked or treated with insecticides. The storage timber colonized by stem pests also need to be barked, and its crust has to be burnt or treated with insecticides. Trap stems need to be barked and treated with insecticides after pests colonized them.

Due to the massive spruce desiccation and, as a result, large volumes of logging, it is necessary to treat with insecticides the timber that cannot be taken from the forest in time by wood users. For

these purposes according to the "State Register ..." [2] the following six insecticides were allowed in the country: Gigant, RP; Tanrek, SC; Karate Zeon, ISO; Vitan, CE; Fastak, CE; Sumi-Alpha, CE. However, this list is even shorter, as in 2007 in accordance with the standards of the policy on pesticides of Forest Stewardship Council (FSC) whole groups of pesticides, including pyrethroids were prohibited for the use in State Forestry Institutions that are being certified or were certified in forest management and forest utilization. In March 2015, a new standard for FSC Forest Stewardship Council system (FSC-STD-30-001) came into operation and a list of pesticides, prohibited for use, was significantly expanded. Since September, 2015 the use of all insecticides included in the "State Register ..." [3], with the exception of Aktara, WDG, was prohibited in the FSC-certified forest enterprises of the Republic of Belarus, which is now more than 80. Thus, there left no preparation permitted for the protection of harvested timber from stem and technical pests in those forestries. Therefore, registration trials of a biological preparation aktofit, CE, that is not registered for protection of harvested timber from spruce stem pests, and its inclusion in [3] for this purpose are of great practical importance. Aktofit, CE is a preparation of biological origin. The active substance is a complex of natural avermectins, which are produced by non-pathogenic soil fungus *Streptomyces*

tomyces avermitilis (Kim and Goodfellow). The preparation is highly effective against mites, Colorado potato beetles, seedworms, thunder flies, weevils, sawflies, aphids, and others. The treatment of plants is carried out by spraying. Penetrating into the body of the insect the preparation irreversibly affects his nervous system, subsequently causing dying. The advantage of this preparation is its safety for warm-blooded animals and humans, the absence of addiction by pests. Aktofit does not accumulate in soil, water, plant foods [4].

Main part. The experimental work on the test biological preparation Aktofit 0.2%, CE (“Industrial and scientific enterprise “Ukrzoovetprompostach”, Ukraine) for the protection of harvested timber from spruce stem pests were conducted in the Central forest area Negorelsky experimental forestry on three spruce trees harvested in mixed planting (consist of 60% of pine, 30% of spruce, 10% of birch), 70 years of age, native to the type of forest growth conditions B₂. The average diameter of the trees at a height of 1.3 m from the butt ranged from 25.5 to 30.5 cm, height – from 22.5 to 25.0 m, age – from 64 to 70 years. Total treated 21 m² wood surface. The protective treatment of the harvested timber from spruce stem pests was held by spraying, taking into account recommendations of the registration trials of insecticides.

The field tests of a biological preparation of Aktofit 0.2%, CE was preceded by laboratory evaluation of its biological effectiveness. Aktofit is not registered in forestry and preliminary assessment of its toxicity to bark beetle was performed in order to choose the concentrations and flow rate to obtain the necessary efficiency. Methods of test were chosen taking into account the existing recommendations [5]. The beetles for the experiment caught on spruce trees were placed on filter paper in a petrie dish and then were sprayed with the solution of Aktofit in concentrations of 0.1; 0.2; 0.3; 0.4 and 0.5% of the working fluid flow rate 0.02 ml/cm². In control dishes the spraying was with pure water. The test was conducted three times, on 10 insects each time.

Accounting beetle mortality during the first days after treatment, it was noted that all the insects in the experimental petrie dishes died. In the control dishes the death of beetles was not observed. Thus, the biological effectiveness for each tested concentration of a biological product was 100%.

In the field Aktofit 0.2%, CE has been tested at the time of flight and colonization of wood by bark beetles in the period from 5 to 19 June 2015, at several concentrations: 0.1, 0.2, 0.3, 0.4 and 0.5% for the preparation in triplicate. The flow rate of the operating fluid was 0.8 l/m². In control group the timber was treated with clear water at the same rate.

As a reference in the treatments there was used insecticide Karate Zeon, ISO (“Syngenta

Crop Protekshn AG”, Switzerland) at a concentration of 0.5% for the preparation included in [3], and allowed for the processing of harvested timber.

The working liquid of the preparation was prepared immediately before the treatment. The indicators of population and development of bark beetles on the treated trees were counted in circular mosaic on the third day after spraying in order to account for the death of their parental generation, and then on the 7th and 14th day observing the duration of action of preparations and their influence on the development of immature stages.

In applying the preparation Aktofit 0.2% CE, sufficiently high efficiency is marked in the processing at concentrations of 0.4 and 0.5% in the preparation. The mortality of the parental generation of bark beetles after preparation treatment at a concentration of 0.4 and 0.5% on the third day was 80.9 and 86.6%, and on the 7th day – 82.2 and 89.9% respectively (Table 1).

The death of the beetles in the control group in all versions was not observed during the period of the experiment. Simultaneously, as the colonization of trees continued, increase in the numbers of the pest on the control palettes on the accounting days was registered.

In areas treated with Aktofit at concentration 0.1 and 0.2% for the preparation, single new colonizations of bark beetles were registered on the 7th day. However, those settled bark beetles died, indicating a high residual activity of the insecticide action of a biological preparation. During the following control on the 14th day new settlements were noted in all areas treated with Aktofit, but the death rate of new bark beetles was much lower.

The death of the young generation of stem pests in the immature phases of development was not observed. Only in some cases, the inhibition of the activity of larvae and pupae was observed on the 7th day after the treatment, but in the future, during the control on the 14th day, their ability to live was fully recovered. There were no deaths of the representatives of useful entomofauna during the tests.

According to criteria accepted in forestry the effectiveness of biological insecticides is the following: 85% or more – good, 70–84% – satisfactory, and less than 69% – weak [6].

We also carried out the assessment of the biological effectiveness of bioinsecticide Aktofit against *Aradus cinnamomeus* in field conditions. Tests were carried out on pure cultures of pine stands in the Central forest area Negorelsky experimental forestry. Insecticide Tanrek, SC, permitted for use in forest plantations was selected as a reference. Counting of the number of pests and evaluation of biological efficiency were conducted in accordance with the existing guidelines on the registration trials of pesticides [5].

Table 1

Biological efficiency of Aktofit 0.2%, CE against stem pests on the harvested timber

Teat variant	Concentration for preparation, %	The number of bugon the control days, num./dm ²						Biological efficiency on the control days, %		
		3		7		14		3	7	14
		alive units	dead units	alive units	dead units	alive units	dead units			
Aktofit 0.2%, CE	0.1	0.70	1.32	0.73	1.52	1.00	1.29	65.3	67.6	56.3
	0.2	0.33	0.94	0.59	1.58	0.95	1.37	69.7	72.8	59.1
	0.3	0.30	1.27	0.33	1.55	0.65	1.52	74.0	82.4	70.0
	0.4	0.47	1.08	0.36	1.67	0.55	1.47	80.9	82.2	72.8
	0.5	0.19	1.23	0.19	1.69	0.36	1.19	86.6	89.9	76.8
Reference – Ka-rate Zeon, 5% ISO	0.5	no	1.80	no	1.51	no	0.93	100.0	100.0	100.0
Control group – water	–	2.33	no	2.40	no	3.02	no	–	–	–

Table 2

Biological efficiency of Aktofit 0.2%, CE against *Aradus cinnamomeus*

Variant	The average number of bugs, num./dm ²			Biological efficiency, %	
	Before treatment	After treatment		On the 3th day	On the 7th day
		On the 3rd day	On the 7th day		
Control (water)	4.70	4.45	4.11	–	–
Tanrek (reference), 0.5 l/ha	3.52	1.06	0.80	69.8	77.3
Aktofit, CE 0.4 l/ha	3.11	1.50	1.33	51.6	57.1
Aktofit, CE 0.5 l/ha	5.05	1.83	1.57	63.7	68.9
Aktofit, CE 0.6 l/ha	4.32	1.29	1.15	70.2	73.4

Table 2 shows the results of the trials of insecticide Aktofit 0.2%, CE against *Aradus cinnamomeus*.

This biological preparation provided the biological effectiveness in experiments against *Aradus cinnamomeus*, leading a hidden life, with a flow rate of 0.6 l/ha, on the 7th day on the level of the reference, that was a chemical insecticide Tanrek, SC (0.5 l/ha), recommended for use on forest stands. It is quite high efficiency, considering that Aktofit 0.2%, CE refers to biopreparations.

Conclusion. Fairly high mortality rates of xylophages were received in assessing the effectiveness of the biological insecticide Aktofit 0.2%, CE for protection of harvested timber from stem pests; it shows the availability of this preparation for this purpose. The use of this biological insecticide at concentrations of 0.4 and 0.5% for preparation with operating fluid flow rate of

0.8 l/m² was effective. In this case, retreatment after 10–14 days is recommended if there is a necessity of the time increase of storage of timber in the forest. Taking into consideration the ecological safety of the biological insecticides, which meets the requirements of the forest certification of FSC international organization, Aktofit can be used at all times of logging (without violating the terms of its storage in the forest) and computation trapping wood against different generations of xylophagous.

Bioinsecticide Aktofit 0.2%, CE also showed relatively high efficiency against *Aradus cinnamomeus*. Its application at the flow rate of 0.6 l/ha provided biological effectiveness (73.4%) on the 7th day on the reference level (77.3%), recommended for use on forest crops. All of this allows to hold the state registration of a biological preparation of Aktofit 0.2%, CE for its inclusion in the “State Register ...”.

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