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ASSESSMENT OF PHYTOTOXIC ACTION OF INSECTICIDES ON SCOTCH PINE (*PINUS SILVESTRIS*) SEEDS

The results of assessment of phytotoxic action of several contemporary insecticides on pine seeds germination are presented. It was found that this pesticides don't show inhibitory influence on germinating seeds, that allows to recommend investigated insecticides for further assessment of their biological efficacy against pests of pine stands.

Introduction. Pesticides including insecticides as biologically active substance can show physiological activity towards plants. [1]. Necessity of assessment of such activity depends on the composition of (active ingredient), concentration, consumption rate, way and conditions of appliance, arise during the choice of protection means of the plants. Nowadays in forest estate land application of 13 insecticides against phytophages is allowed [2], however in GFFA where the system of forest administration is certified in accordance with the FSC standards, 7 insecticides from this list, mainly synthetic pyrethroids, are prohibited for application. National register [2] permits application of 5 more biological products of insecticides action but at present this entire assortment of insecticides by no means corresponds with the needs of forest protection, this is especially relates to the problem of forest plants protection from the injurious organisms. For the purpose of the possible enlargement of the list of insecticides allowed for application against injurious organisms of forest plants we conducted the assessment of phytotoxic action of the products already included in the National register but on other objects (kind of plants).

Main part. During the testing of the insecticides the important factor is their ability to provoke injury of the plants (phytotoxicity) which can be either temporary or permanent. Inhibition of the plants can be without external symptom occurrence (decrease of dry matter accumulation, stagnation and juvenilism, pollen grain devitalizing etc.). Besides negative influence on the plants is observed and in the form of various symptoms – germinative power and energy decrease, leaf and pine needle burn (marginal necrosis on leaves and pine needles or necrosis spots), their deformation (crooking, exfoliation, brashness), tissue and parts dying off, fading of leaves, pine needles, parts and entire plants, colour changing (decolouring – chlorosis or unusual colour), abnormality of growth (growth retardation or acceleration of the separate parts or entire plant), formative defection of the parts or plants of the typical kind, resin- and gum bleeding etc.

External symptoms of damages are taken into consideration during examination of plants and usually assessed in accordance with the percentage of injuries in comparison with unprocessed control samples. Phytotoxicity can be observed on the plants during their growth after processing, in this case symptoms of damages can appear as on the entire plant and on the leaves, pine needles, spears and so on. In case there are a considerable number of several types of damages they are assessed separately. In this case insecticides can either have positive stimulatory effect on the plants. Stimulatory effect can be observed in regards to the acceleration of the germinating ability of seeds, growth acceleration, development and ripeness of plants etc.

While choosing the assortment of insecticides for forest plants protection from phytophages we had special tests on the assessment of their phytotoxicity in accordance with the existent methods [3]. Germinating seeds are considered to be the most sensitive to the toxic effect that is why soaking of pine seeds with their followed germination was used. This lets to notice the departure from the accepted standards just during the germination and appearing of sprouts. The testing was carried out in 7 variants in 4 replications at 100 seeds with the control and etalon in accordance with the existing methods [3, 4].

In the experiment the following insecticides were used: confidor extra, WDG (imidacloprid, 700 g/kg) in the concentrations of 0.10 and 0.15%, fufanon, EC (malathion, 570 g/l) in the concentration of 0.20%, actara, WDG (tiametoxam, 250 g/kg) in the concentration of 0.15% as the etalon, phytoverm, EC (aversectin C, 2 g/l) in the concentration of 0.20%,vertimek, EC (abamektin, 18 g/l) in the concentration of 0.20%. Insecticides actara ("Syngenta", Switzerland) and confidor extra ("Bayer", Germany) relate to the modern product group – neonicotinoids with systemic action. Fufanon ("Cheminova", Denmark) – organophosphorous insectoakaricide consists of the same active ingredient as popular in its time karbofos and has contacting, deep and partly fumigational action. Vertimek and phytoverm (LLC "Pharmbiomethod", Russia) relate to avermectins – insec-

toacaricides of natural occurring based on soil microbial products have contact-intestinal action [1, 2, 4–6]. Testing was built on soaking of seeds in the water. All products under testing are allowed for application in GFFA by FSC in accordance with FSC policy on pesticides. Within the testing insecticides were applied in normal or a bit elevated in comparison with recommended concentration (in 1.5–2.0 times) that let to assess real phytotoxicity in its presence. During the testing self-adjusting germinator RUMED was used.

Results of seed germination in accordance with recording days are presented in table 1. According to the research regular germinated seeds appeared on the 5th day of the recording. This day turned out to be peaking for seed germination especially in the variant with vertimek. During the entire testing there wasn't observed any significant difference as for the number of germinated seeds between the testing variants and the control. Data analysis shows that a number of tested insecticides made a specific action on seed germination. It should be mentioned positive action of fufanon. Technical germination in this case was 80.5% versus 80.0% in the control. In all other cases low inhibitory action of insecticides on seed germination was observed. To define the accuracy of the obtained results we carried out their statistical analysis (table 2, 3).

Table 1

Recording of Scotch pine seed germination

Variant of testing	Number of seeds	Number of seeds according to the recording results days, pcs.					Total germinated, pcs.	Total non-germinated, pcs.	Technical germination, %
		3rd	5th	7th	10th	15th			
Aktara, 0.15%	Regular germinated	–	138	102	64	10	314	86	78.5
	Left on the bed	400	262	160	96	86			
Konfidor extra, 0.10%	Regular germinated	–	126	104	60	8	298	102	74.5
	Left on the bed	400	274	170	110	102			
Konfidor extra, 0.15%	Regular germinated	–	180	62	38	10	290	110	72.5
	Left on the bed	400	220	158	120	110			
Phytoverm, 0.20%	Regular germinated	–	160	76	64	18	318	82	79.5
	Left on the bed	400	240	164	100	82			
Vertimek, 0.20%	Regular germinated	–	210	56	38	4	308	92	77.0
	Left on the bed	400	190	134	96	92			
Fufanon, 0.20%	Regular germinated	–	146	90	74	12	322	78	80.5
	Left on the bed	400	254	164	90	78			
Control (water)	Regular germinated	–	136	120	60	4	320	80	80.0
	Left on the bed	400	264	144	84	80			

Table 2

Statistical processing of the recording seed germination results in variants of the testing

Statistical data	Testing variants						
	control	aktara, 0.15%	konfidor extra, 0.10%	konfidor extra, 0.15%	phytoverm, 0.20%	vertimek, 0.20%	fufanon, 0.20%
$\bar{x}$	80.00	78.50	74.50	72.50	79.50	77.00	80.50
S	3.16	5.48	2.18	3.33	2.64	2.71	2.37
$S_{\bar{x}}$	1.58	2.74	1.09	1.66	1.32	1.35	1.18
V, %	3.95	6.98	2.93	4.59	3.32	3.52	2.94
P, %	1.98	3.49	1.46	2.29	1.66	1.75	1.47
$\bar{x} \pm t_{05} S_{\bar{x}}$	80.00 ± 5.02	78.50 ± 8.71	74.50 ± 3.47	72.50 ± 5.28	79.50 ± 4.20	77.00 ± 4.29	80.50 ± 3.75

Table 3

Judgement of materiality of mean difference on *t*-criterion

Variant of testing	Average technical germination, %	t_{fact}	t_{theor}
Aktara, 0.15%	78.50 ± 8.71	0.47	2.45
Konfidor extra, 0.10%	74.50 ± 3.47	2.86	
Konfidor extra, 0.15%	72.50 ± 5.28	3.28	
Phytoverm, 0.20%	79.50 ± 4.20	0.24	
Vertimek, 0.20%	77.00 ± 4.29	1.44	
Fufanon, 0.20%	80.50 ± 3.75	0.25	

Conclusion. Modern insecticides in recommended concentrations practically don't have any significant toxic or stimulatory action on technical seed germination of the pine tree. This let to recommend them for further testing against insects-phytophages on forest plants. Calculated criterion of mean difference revealed that inhibitory action on seed germination of the products aktara, vertime and phytoverm isn't true and is within the bounds of random vibration under the accepted level of significance ($t_{fact} < t_{theor}$). It was revealed that konfidor extra in tested concentrations had proved inhibitory action on seed germination that let to tell about its certain phytotoxic action on plants ($t_{fact} > t_{theor}$).

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