IMPLEMENTATION OF SOME BIOPESTICIDES IN THE INTEGRATED PEST MANAGEMENT OF LARGE PINE WEEVIL *HYLOBIUS ABIETIS L.* (*COLEOPTERA – CURCULIONIDAE*)

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The large pine weevil Hylobius abietis is one of the main plantation pests and without forestry measures the losses are big, produced by the drying of the seedlings. The researches aimed at the replacement of some chemical insecticides, recommended by the existing technologies, with two bio-pesticides, within the pine weevil integrated management: spinosad and azadirachtin. The treatments were applied on leaves and treated barks on both faces 30/30 cm, laid with the inner side down and covered by dirt. Spinosad in a concentration of 0,066% protected the sapling against the large pine weevil's attack; during three weeks on the treated barks there were found 2-5 dead adults. The entomophagi, like carabids and ants were not affected, unlike in the case of Sinoratox 5G, which can destroy these species.

The azadirachtin bio-product was applied both on barks and leaves as 5% and 10% water emulsion. Although, during the experiments, there were not found any dead adults, the product had an antifeedant effect, deterrent of feeding and a repellent action; the treated samplings presented small damages. Because the bio pesticide did not have a direct action on adult stages and there are many aspects unclear, the researches must be continued

Key words*: Hylobius abietis, spinosad, azadirachtin, biopesticide*

The large pine weevil is the main pest of the resinous and unless integrated pest management (IPM) is respected, great losses result. In IPM, forestry measures are of special importance, particularly that of adopting a two years "rest" period between the cuttings and the planting for the clear cut areas and juxtaposing them after a minimum of five years [8] period. From the practical application of these measures there have been noticed some inconveniences, such as excessive grassing, lesions etc. Under the risk of an attack, the chemical measures to be taken are the showering of the saplings with pyrethroid insecticide solutions (Faster 10CE, Decis 2.5 CE) and the treatment of the toxic bark with pyrethroids or with Sinoratox 5G. We can appreciate that from the point of view of preserving biodiversity and of sustainable management of forests even the use of less polluting pyrethroides can affect entomophagi.

Thus, we can point out a few characteristics of biopesticides used in experiments. Spinosad attaches to two or several proteins that act on nicotinic-acetylcholine receiver and produces a sodium ion flux which depolarizes neurons and hyper activates them, thus continually contracting the muscles and inducing paralysis. As it acts on the only receiver of the insects' nervous system, unlike other today's known products, it does not produce cross resistance in combination with the known synthetic and biological insecticides [14, 15]. Its efficacy resembles that of the majority of synthetic insecticides but it is significantly faster than that of *Bacillus thuringiensis* bacteria or that of *Beuveria fungus* and other biological products. After the exposure of the insects to the product, feeding stops immediately and the insects get paralysed. The product is not systemic, but it translaminates, ranging itself in group 4 of toxicity. It has effect on Lepidoptera and orchard minatory fly, vegetable cultures and ornamental plants [13] and a large spectrum of use against hymenopterans, lepidopterans, coleopterans, thysanopterans and isopterans. It can be applied to over 200 cultures, in controlling caterpillars at cotton and cabbage and minatory insects. For the large pine weevil there have been made numerous laboratory and on field researches in order to introduce these neem products in the integrated management [1, 3, 4, 5, 9, 16, 17].

The researches were meant to implement some biological products in the integrated management of the large pine weevil (spinosad – Laser 240SC, azadirachtin – NeemAzal T-S) in order to replace chemical insecticides.

MATERIAL AND METHOD

There were tested the Laser 240 SC (spinosad) bio pesticide, produced from the fermentation of actinomycete *Saccharapolypospora spinosa*, the active ingredient of the first commercial product from Naturalyte line of the company Dow AgroScience and NeemAzal T-S (azadirachtin 1%), an extract of *Azadirachta indica* seeds, produced by the company Trifolio – M Ltd.

The experiments were done in Pojorata Forest District, U.P. III, Valea Putnei, u.a. 130A, in 2006-2007. The large pine saplings were planted a year after a clear cutting in order to have a powerful attack. In 2006 the treatment was applied against adults, that were making summer bite, and in 2007 for the spring bite, by leaf spraying and toxic barks of 30/30 cm, laid on the ground, slime down and covered with dirt, surface of the variant being of 500 square metres. We must add that spinosad was applied on both sides of the treated barks, because the bio insecticide decomposes rapidly in contact with the soil. In 2006 the treatment was applied in August the 7th and records were made on August the 30th; in 2007 the treatment was applied on May the 11th and observations were made on June the 9th.

RESULTS AND DISCUSSIONS

From the experiment made in 2006, we can appreciate that the spraying of bio pesticides on saplings led to a good protection, with all variants, the observations being made 23 days after the treatment (*tab. 1*). Thus, the degree of attack on the saplings' bark was of 0-2%, compared to 50% on the untreated control assay.

Table 1

Mortality of *Hylobius abietis* and *Hylastes sp.* adults after treatment application, 2006

Variants	Concen-tration %	Adults/ bark			GA%
		Hylobius abietis		*Hylastes sp.*	
		deads	alive	deads	
1. Spraying with Laser 240 SC	0,016	-	-	-	2
2. Spraying with Laser 240 SC	0,033	-	-	-	2
3. Spraying with Laser 240 SC + Nu Film 17	0,066 + 1	-	-	-	2
4. Spraying with Laser 240 SC+ Nu Film 17	0,033 + 1	-	-	-	0
5. Toxic barks with Laser 240 SC	0,066	2	0	5	2
6. NeemAzal T/S	10	-	-	-	0
7. NeemAzal T/S + Nu Film 17	10 + 1	-	-	-	0
8. Toxic barks with NeemAzal T/S	10	0	1	0	0
9. Untreated control	-	-	-	-	50

Depending on the adults noted on the toxic barks, the attack of the large pine weevil was considered from strong to very strong. The treated barks were efficient on the average; at the variant with Laser 240SC we could observe 2 dead adults/ bark and 4-5 Hylastes sp./bark. At the variants with NeemAzal - T/S, both after the foliar and the bark treatment, there were no dead adults but there were also no stings to induce the death of the saplings.

During the next year, the attack of the large pine weevil was very strong, that time with spring bite (*tab. 2*). The variant of the bark treatment with Sinoratox 5G was introduced, in order to measure the impact on entomophagi. At foliar treatment, particularly at the variant with Spinosad 0.033%, there could be noticed 0.2 dead adults/ sapling. Generally, the treated saplings did not present stings. At the variants where NeemAzal T/S foliar treatment was applied, within one or two days over 28% of the saplings presented live adults, but without an intense feeding activity. Removed from the treated saplings or barks and placed in laboratory on untreated twigs, the adults did not present any case of mortality within 30 days. The toxic barks treated with Sinoratox 5G presented the largest number of dead pine weevil adults, but also of carabidae, species of predatory insects. A large number of dead adults (5 specimens/ bark) were observed in the case of Laser 240 SC, without affecting the ant colonies or the carabidae species, and this is also valid in the case of NeemAzal T/S, which recommends them for implementation. From these researches, we can observe that the insecticide action of the product covers a period of more than 3 weeks, during which the resinous saplings are protected.

The researches carried out up to the present concentrated mainly on establishing efficiency of synthetic pyrethroides – deltamethrin, labdacyhalothrin, permethrin and neonicotinoides – imidacloprid [6,12]. Other researches were oriented towards the implementation of plant derived or microbian bio pesticides such as Celafor – Neem, Neem, Neko, Anupaan anf Fitoverm [11]. There were also

many researches oriented on finding metabolites of the antifeedant type, which, applied on saplings, inhibit the feeding of pine weevil adults such as neem extract [1], metabolites from plants: borneol, bornyl acetate, carvone, cucurbitacin, myrcene, limonin, 4-allyanisole, alpha-pinene, β-pinene, limonene and coumarin [4].

Table 2

Mortalitatea adulţilor de *Hylobius abietis* după aplicarea tratamentelor, 2007

Variants	Concentration %	Adults *Hylobius abietis* / barks		G.A. %
		deads	alive	
1. Spraying with Laser 240 SC	0,016	-	-	0
2. Spraying with Laser 240 SC	0,033	-	-	0
3. Scoarţe toxice cu Laser 240 SC	0,066	5	0	3
4. Spraying with NeemAzal T-S	10	-	-	0
5. Spraying with NeemAzal T-S	5	-	-	0
6. Toxic barks with NeemAzal T-S	10	0	2	0
7. Untreated control	-	-	-	50
8. Toxic barks with Sinoratox 5G	1kg/100 scoarţe	10	0	0

In general the experiments with insecticides of microbian type are quite rare, the results being linked to Fitoverm. There are not known technologies that implement such products. As for the efficiency of spinosad (Laser 240 SC) in pine weevil control on resinous saplings, it is evident that it acts very well on adults rather by ingestion than by contact and it has a relatively long residual action, of up to three weeks. Compared to chemical insecticides the bio pesticides do not affect predatory species (carabidae and ants) and they are evaluated as good at conservation of parasites, many experiments being situated in classes 3 and 4 IOBC [20].

We must highlight the good efficiency of the product applied on the resinous saplings' leaves, but also on the toxic barks. This alternative of ecologic control encourages the amplification of researches on the efficacy of other microbian derivates.

There are disagreements about the way of action, concentration and duration of the residual effect of NeemAzal – T/S bio pesticide. First, the neem acts like a deterrent and inhibitor of feeding (antifeedant) and practically there are not spectacular results of adult mortality. There has been mentioned the repellent effect during the whole vegetation period, which was more stable at the concentration of 20% [16], but which can be phytotoxic. At the same dose, there can be obtained a maximum efficacy in the first two weeks [7]. Bryan 2007 [3] mentions that at the concentration of 10% the damages produced by the pine weevils are reduced but he also points out the residual effect that lasts for 16 weeks. A strong activity of pine weevil damage reduction in the first three weeks can be obtained with NeemAzal Paint (40% vegetable oil dilution) [17]. Besides, in laboratory experiments there were not recorded differences as to the mortality of young adults caused by the undiluted product or in a concentration of 20%, this happening after 12 weeks of

continuous feeding [10] which makes unnecessary the increasing of the treatment concentration. An optimum economic dose would be that of 10% and not that of 5%, to which males had a more significant reaction than females [5]. A large number of treatments, meant to be used in high concentrations, would not be economically profitable due to the big costs. Considering the conditions in the plantation as well as those in the laboratory [9], when weevils preferred untreated saplings, after a contact with or feeding on treated plants, the inhibition of feeding and repellence play a major role. From our experiments, although adults were present on saplings treated with NeemAzal – T/S in concentration of 5% and 10%, they produced a small number of stings due to the antifeedant and repellent characteristics of the product, during the observation period no withered saplings being noticed. For the clarification of the way of action and economic aspects of the application, further researches are necessary.

CONCLUSIONS

We can conclude that spinosad (Laser 240SC) protected the resinous saplings from the pine weevil *Hylobius abietis* and ipid beetle *Hylastes sp*. attack, through treatments applied on leaves or on toxic barks. The bio pesticide did not influence negatively the predatory entomophagi. Its implementation in the control technology will reduce environmental pollution and will affect less the biodiversity of entomophagous species.

The neem (NeemAzal – T/S) applied in concentrations of 5% and 10% protected the resinous saplings by the antifeeding and repellent effect and less by causing immediate death, thus the entomophagous fauna remaining unaffected. Because it did not have a direct action on adults and there are several aspects that need clarifications, the researches must continue.

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BIBLIOGRAPHY

1. Beitzenheineke, I., Hofmann, R., 1992 - *Experiment on the effect of an azadirachtin-containing preparation AZT-VR-NR on Hylobius abietis L., Lymantria monacha L. and Drino inconspicua Meig*, Journal of Plant Diseases and Protection, 99 (4), p. 337-348.
2. Bret, B.L., Larson, L.L., Schoonover, J.R., Sparks, T.C., Thompson, G.D., 1997 - *Biological proprieties of Spinosad*, Down to earth, vol. 52, (1), p. 6-13.
3. Bryan, W., 2004 - *Efficacy of plant protection products containing the botanical antifeedant, Azadirachtin, against the large pine weevil (Hylobius abietis),* Biological Control of Plant, Medical and Veterinary Pests, Workshop, Wetzlar, Germania, Druckand Graphic Giessen, p. 30.
4. Kier, D.K., Schlyter, F., 1999 - *Laboratory evaluation of plant-derived antifeednts against the pine weevil Hylobius abietis* (*Coleoptera: Curculionidae*), Journal of Economic Entomology, 92 (3), p. 644-650.
5. Luik, Anne, 2000 - *Die Wirkung von NeemAzal – T/S auf den Fortpflanzungfrass des grossen braunen Rüsselkäfers* (*Hylobius abietis L.*), Practice Oriented Results on Use Productions of Neemingredients and Pheromones, Proc. 8-th Workshop, Hohensolms, p. 33-37.

6. Luoranen, J., Virri H., 2005 - *Insecticides sprayed on seedlings of Picea abietis during active growth: Damage to plants and effect on pine weevils in biossay*, Scandinavian Journal of Forest Research, 20 (1), p. 47-53.
7. Metspalu, L., Luik, Anne, Hiiesar, K., Kuusik, A., Sibul, I., 2000 - *On the influence of neem preparations on some agricultural and forest pests*, Proceedings of the 9-th Workshop, Practice Oriented Results on Use and Production of Neem –Ingredients and Pheromones - H. Kleeberg and C.P.W. Zebits (Eds.), p. 85-92.
8. Olenici, N., Olenici, Valentina, 1994 - *Hylobius abietis L.*, *unele particularităţi biologice, ecologice şi comportamentale şi protecţia culturilor împotriva vătămărilor cauzate de acesta* (II), Bucovina forestieră, anul II, nr. 2, p. 42-53.
9. Olenici, N., Olenici, Valentina, 2006 - *Antifeedant effect of NeemAzal T/S on the large pine weevil Hylobius abietis L*, Analele ICAS, 49 p. 107-118.
10. Olenici, N., Olenici, Valentina, 2006 - *Efectele insecticidului NeemAzal T/S asupra hrănirii, vitalităţii, mortalităţii şi fecundităţii gândacilor de Hylobius abietis L.*, Revista pădurilor, nr. 4, p. 3-17.
11. Ploomi Angela, Metaspalu L., Hiiesaar K., Sibul I., Luik A. 2005 - *The use of some biopesticides in pest control,* Agronomy of EAU, 220, p. 198-200.
12. Rose, D., Leather, S.R., Matthews, G.A., 2005 - *Recognition and avoidance of insecticide – treated Scots Pine* (*Pinus sylvestris*) *by Hylobius abietis* (*Coleoptera: Curculionidae*): *implications for pest managements strategie*, Agricultura and Forest Entomology, 7 (3), p. 187-191.
13. Salat, V., 2000 - *Haricot vert – essai phytosanitaire*, Proceedings of the 9-th Workshop, Hohensolms, Germania, Practice oriented results on use and production of Neem – ingredients and Pheromones, p. 127-138.
14. Salgado, V.L., 1997 - *The modes of action of Spinosad and other insect control products*, Down to earth, vol. 52, p. 35-43.
15. Salgado V. L., 1998 - *Studies on the mode of action of spinosad: the internal effective concentration, and the concentration dependence of neural excitation*, Pesticide Biochem. Physiol., 60, p. 103 – 110.
16. Sibul, I., Luik, A., Voolma, K., 2001 - *Posibilities to influence maturation feeding of the large pine weevil, Hylobius abietis L., with plant extracts and neem preparations,* In Proceedings of the International Workshop Tartu, Estonia, p. 128-137.
17. Sibul, I., Angela, Ploomi, 2004 - *Impact of some biopesticides on the feeding activity of the large pine weevil* (*Hylobius abietis* L.) (*Coleoptera: Curculionidae*), Biological Control of Plant Medical and Veterinary Pests, Workshop, Wetzlar, Germania, Druck and Graphic Giessen, p. 51.
18 Thompson, G.D., Michel, K.H., Zao, R.C., Mynderse, J.S., Mosburg, C.T., Worden, T.V., Chio, E.H., Sparks, T.C., Hutchins, S.H., 1997 - *The discovery of Saccharopolyspora spinosa and a new class of insect control product*, Down to earth, vol. 52, nr. 1: 1-5.
19. Thompson, G.D., Dutton, R., Sparks, T.C., 2000 - *Spinosad – a case study: an example from a natural products discovery programme,* Pest management Science, 56, p. 696 – 702.
20. Trevor, W., Javier, V., Elisa Vinuela, 2003 - *Is the naturally derived insecticide Spinosad compatible with insect naturale enemies?*, Biocontrol Science and Technology, vol. 13, p. 459-475.