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RESEARCH CONCERNING THE EFFECT OF SYNTHETIC PHEROMONES ON *PITYOGENES CHALCOGRAPHUS* L. IN BRAŞOV COUNTY

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Abstract: *In this paper we study one of the most important bark beetles of spruce, namely the six-spined spruce bark beetle (Pityogenes chalcographus L.). For this species of Scolytinae we tried to achieve two main objectives: testing the efficiency of two types of synthetic pheromones and study of the local flight dynamics of this insect. Therefore, it is necessary to know the local characteristics of the flight of the six-spined spruce bark beetle in order to be able to intervene at the moment when the population begins its outbreak.*

Key words: *six-spined spruce bark beetle, synthetic pheromones, efficiency of pheromones, dynamics of the flight.*

1. Introduction

Pityogenes chalcographus L. (Coleoptera, Scolytinae) is one of the most commonly found pests of Norway spruce [5], [6], [15], [16], [23], [27]. The beetle is not strictly monophagous and other species of the genus *Picea* as well as *Larix sp.*, *Pinus sp.* and *Pseudotsuga sp.* may serve as hosts [10], [23], [27].

It often occurs together with *Ips typographus* L. and infests the upper part of trees, while *I. typographus* attacks the middle and lower parts [15].

P. chalcographus the ability to kill alone healthy trees seems low [12], [13]. The attacks of this insect appear in conditions of physiological perturbations caused by different factors. The insect prefers stressed and recently felled trees and logging residue [10]. At high density population, it attacks also healthy trees, therefore preparing the breeding material for *I. typographus* [10], [11], [15], [17].

This species prefers sites only slightly exposed to sunshine [4], [15]. This species is of a high importance in young stands weakened by defoliators, where it can occur and cause damage itself [15].

Adults prefer to attack portions of the tree with thin bark [11]. On smaller trees, attacks occur along the entire length of the tree and red needles crown symptoms will be quite visible [9], [11], [22]. On larger trees, attacks initially occur high on the stem and foliar colour change is not usually evident, then attacks may occur progressively lower on the trunk [9], [22].

Depending on altitude and temperature one or two generations exist per year [4],

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[15]. All ontogenetic stages are able to hibernate, in either the bark or the forest litter [4], [24].

2. Objectives

Because there are few data concerning the *Pityogenes chalcographus* in Romania we tried to achieve two main objectives: (*i*) Testing the efficiency of different synthetic pheromones (Langlock Kupferstecher Dosierflasche, AtraCHALC); (*ii*) Study of the local flight dynamics of the insect.

3. Research Areas, Materials and Methods

The experimental plots were placed in Norway spruce stands with infested standing trees, as follows: 55, VI Tâmpa Management Unit, altitude of 650 m (Experimental plot Poiana Braşov), and subcompartment 58, V Noua Management Unit, altitude of 920 m (Experimental plot Iepure), Local Department of Forests Kronstadt R.A. Braşov (Figure 1).

Fig. 1. *Samples of the experimental plot Poiana Braşov and flight Intercept trap* (*left*) *and experimental plot Iepure* (*right*)

In each experimental plot we installed three pairs of flight Intercept traps, loaded with two types of lures (Figure 2): AtraCHALC (Romania - Raluca Ripan Institute for Research in Chemistry) and Langlock Kupferstecher Dosierflasche (Germany - FLÜGEL GmbH).

Fig. 2. *Stock way of pheromones: as a dispenser - AtraCHALC* (*left*) *and as a little bottle - Langlock Kupferstecher Dosierflasche* (*right*)

The traps were placed at a minimum distance of 30 m between them. The distance between trees and traps was of minimum 10-15 m.

The captured biological material was collected one time per week between April 16th and July 31st 2009.

The replicates were assured by rotating the lures from one trap to another during the entire experiment. In this way, the possible influence on catches by the field conditions was avoided.

The results were compared by using the index **Ia** = intensity of attraction, representing the number of captured insects per day and trap.

4. Results and Discussions

4.1. Results regarding the capture dynamics

There are few data concerning the flight dynamics of *Pityogenes chalcographus* in Romania [7], [20], [21].

Our specialty literature says that adults overwinter in the forest litter (80%) or under the bark of trees [25]. *Pityogenes chalcographus* has a threshold of temperatures about 16.8-17 °C for activity [18].

The first flight occurs between mid April to mid June, as we can see in the diagram below.

By analyzing Figure 3 one can observe that the maximum of the flight is reached between June 4th and June 11th in both plots. For the entire catching period, the daily capture was of 97.14 insects/day/trap in Iepure plot, much higher than that in Poiana Braşov plot (34.52 insects/day/trap).

The drastic reduction of captures during the period April 30th - May 8th is due to the heavy rainfall that took place every day and thus, the mean temperatures decreased under the threshold that releases the flight of bark beetles.

The level of captures increases again in the first week of July and this means the beginning of the second flight.

In the experimental plot Iepure the total number of the six-spined spruce bark beetle caught in 2009 was of 20400 insects, for a period of 105 days.

Fora et al. [7] also establish that in Timiş County, the insect has two flights per year. The first flight was in April, May and June (76-94% from the flight on all growing season), while the second flight was in July and August (6-24% from the flight on all growing season). Mihalciuc et al. [20] recorded that in 1989, by using Chalcoprax lure, the catches dynamics in Prundu Birgaului Forest District highlights a flight period of about 8 weeks that starts in the second half of May and lasts until mid-July [20]. In 2009, in Poiana Braşov and Iepure plots, most catches are concentrated in the same period.

On the other hand, in the Dinaric mountain forests of Slovenia in 1998, *P. chalcographus* had the first maximum on June 8 and, even more distinctively, a second maximum on July 6 [14]. For our studied areas the maximum of the first flight was four times higher than the second maximum on July.

Markovic [19] shows that in Serbia *P. chalcographus* develop one generation in the National Park Kopaonik over the period of 2006-2008. The adults were captured in pheromone traps from the end of May through the middle of September. The hibernating adults were caught mainly from late May until mid-July, and the adults of the new generation were caught in late July, during August and in early September.

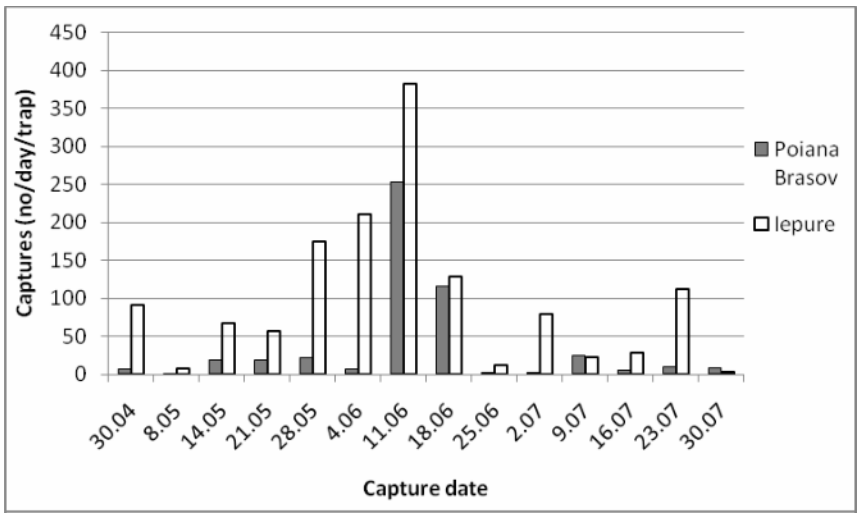

Fig. 3. *Capture dynamics of Pityogenes chalcographus*

4.2. Results regarding the efficiency of pheromones on *Pityogenes chalcographus*

Pityogenes chalcographus is also attracted to a synergistic blend of the pheromone components, chalcogran (2-ethyl-l.6-dioxaspiro[4.4]nonane) and methyl (*E,Z*)-2,4-decadienoate [1-3], [8].

Monoterpenes such as a-pinene from the host increase the attraction response to the pheromone components [3], [26].

In Romania, Raluca Ripan Institute for Research in Chemistry uses a preparation process for (2E,4Z)-2,4 decadienoate that ensures a good efficiency, the reaction conditions easily achieved and accessible materials.

Our study also tries to prove a high efficiency in catching the beetles. The variance analysis of captures (Table 1, Figure 4) shows that there were no significant differences between the capture levels of six-spined spruce bark beetle on the two tested lures.

Table 1

Effect of the date and the type of lure on the Pityogenes chalcographus captures

Plot	Factor	DOF*	F**	P***
Poiana Braşov	Date	13	1.894	0.106
	Lure	1	0.177	0.680
Iepure	Date	13	4.279	0.007
	Lure	1	0.274	0.610

* DOF - degrees of freedom;
** F - Fisher coefficient;
*** P - calculated probability

The date had a significant effect on the catch of *Pityogenes chalcographus* only in the case of experimental plot Iepure. There were no significant differences found between the captures in time in the experimental plot Poiana Braşov probably because here the level of captures was lower than in the experimental plot Iepure.

Since in Romania there is an internal lure especially for this species of *Scolytinae* that could cause economic damages, we recommend the AtraCHALC lure if we consider the higher level of the captured beetles in both experimental plots.

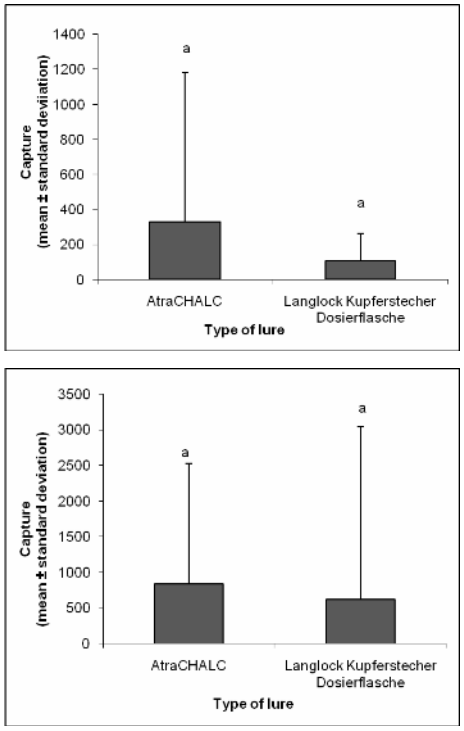

Fig. 4. *Distribution of Pityogenes chalcographus captures per lure at Poiana Braşov* (*up*) *and Iepure* (*down*) (*Columns with the same letter show that the means are not significantly different from each other for P = 0.05*)

5. Conclusions

With this research we found some data for our country on the dynamics of the flight in the case of the six-spined spruce bark beetle *Pityogenes chalcographus* and on the preference of this beetle for different types of lures.

Pityogenes chalcographus had two flights per year in Braşov County in the year 2009. The studied species presented similar flight diagrams in both experimental

plots. It is necessary to know the local characteristics of the flight in order to be able to intervene at the moment when the population begins its outbreak.

For *Pityogenes chalcographus*, our results obtained in 2009 show that the AtraCHALC lure ensures a very efficient attraction and we recommend this lure if we consider the higher level of the captured beetles in both experimental plots.

References

1. Birgersson, G., Byers, J.A., Bergstrom, G., Lofqvist, J.: *Production of Pheromone Components Chalcogran and Methyl* (*e-z*)*-2,4 Decadienoate in the Spruce Engraver Pityogenes chalcographus*. In: J. Insect. Physiol. **36** (1990), p. 391-396.
2. Byers, J.A., Birgersson, G., Löfqvist, J., Appelgren, M., Bergström, G.: *Isolation of Pheromone Synergists of Bark Beetle, Pityogenes chalcographus, from Complex Insect-Plant Odors by Fractionation and Subtractive-Combination Bioassay*. In: J. Chem. Ecol. **16** (1990), p. 861-876.
3. Byers, J.A., Birgersson, G., Löfqvist, J., Bergström, G.: *Synergistic Pheromones and Monoterpenes Enable Aggregation and Host Recognition by a Bark Beetle, Pityogenes chalcographus*. In: Naturwissenschaften **75** (1988), p. 153-155.
4. Byers, J.A.: *Chemical Ecology of Bark Beetles in a Complex Olfactory Landscape*. In: Bark and Wood Boring Insects in Living Trees in Europe, a Synthesis. Lieutier, F., Day, K.R., Battisti, A., Grégoire, J.C., Evans, H.F. (Eds.). Dordrecht. Kluwer Academic Publishers, 2004, p. 89-134.
5. Byers, J.A.: *Host Tree Chemistry Affecting Colonization in Bark Beetles.* In: Chemical Ecology of Insects 2. Cardé, R.T., Bell, W.J. (Eds.). New York. Chapman and Hall, 1995, p. 154-213.
6. Chararas, C.: *Scolytides des Coniferes*. Paris. Paul Lechevalier, 1962.
7. Fora, C.G., Lauer, K.F., Damianov, S.: *Research Regarding the Biology of the Pest Pityogenes chalcographus L.* (*Coleoptera, Scolytidae*) *in the Nădrag - Padeş Area* (*Timiş County*). In: Research Journal of Agricultural Science **39** (2007) No. 1, p. 431-438.
8. Francke, W., Heemann, V., Gerken, B., Renwick, J.A.A, Vité, J.P.: *2-Ethyl-1-6-Dioxaspiro[4.4]nonane, Principal Aggregation Pheromone of Pityogenes chalcographus* (*L.*). In: Naturwissenschaften **64** (1977), p. 590-591.
9. Gothlin, E., Schroeder, L.M., Lindelow, A.: *Attacks by Ips typographus and Pityogenes chalcographus on windthrown spruces* (*Picea abies*) *during the Two Years Following a Storm Felling.* In: Scand. J. For. Res. **15** (2000), p. 542-549.
10. Grodzki, W.: *Pityogenes chalcographus* (*Coleoptera, Scolytidae*) *- an Indicator of Manmade Changes in Norway spruce Stands.* In: Biologia (Bratislava) **52** (1997), p. 217-220.
11. Harding, S., Lapis, E.B., Bejer, B.: *Observations on the Activity and Development of Pityogenes chalcographus L.* (*Col., Scolytidae*) *in Stands of Norway spruce in Denmark.* In: J. Appl. Entomol. **102** (1986), p. 237-244.
12. Hedgren, P.O., Weslien, J., Schroeder, L.M.: *Risk of Attack by the Bark Beetle Pityogenes chalcographus* (*L.*) *on Living Trees Close to Colonized Felled Spruce Trees.* In: Scandinavian Journal of Forest Research **18** (2003) No. 1, 2003, p.39-44.
13. Hedgren, P.O.: *The Bark Beetle Pityogenes chalcographus* (*L.*) (*Scolytidae*) *in Living Trees, Repro-*

ductive Success, Tree Mortality and Interaction with Ips typographus. In: J. Appl. Ent. **128** (2004), p. 161-166.
14. Jurc, M., Perko, M., Džeroski, S., Demšar, D., Hrašovec, B.: *Spruce Bark Beetles* (*Ips typographus, Pityogenes chalcographus, Col.: Scolytidae*) *in the Dinaric Mountain Forests of Slovenia: Monitoring and Modeling*. In: Ecological Modelling **194** (2006) Issues 1-3, p. 219-226.
15. Kolk, A., Starzyk, J.R.: *The Atlas of Forest Insect Pests*. Warszawa. Multico, 1996.
16. Kulinich, O.A., Orlinskii, P.D.: *Distribution of Conifer Beetles* (*Scolytidae, Curculionidae, Cerambycidae*) *and Wood Nematodes* (*Bursaphelenchus spp.*) *in European and Asian Russia.* In: Bulletin OEPP/ EPPO **28** (1998), p. 39-52.
17. Lieutier, F.: *Host Resistance to Bark Beetles and its Variations*. In: Bark and Wood Boring Insects in Living Trees in Europe, A Synthesis. Lieutier, F., Day, K.R., Battisti, A., Grégoire, J.C., Evans, H.F. (Eds.). Dordrecht. Kluwer Academic Publishers, 2004, p. 135-180.
18. Lobinger, G.: *Die Lufttemperatur als limitierender Faktor für die Schwärmaktivität zweier rindenbrütender Fichtenborkenkäferarten, Ips typographus L. und Pityogenes chalcographus L.* (*Col., Scolytidae*). In: Anz. Schädlingskde, Pflanzenschutz, Umweltschutz **67** (1994), p. 14-18.
19. Markovic, C., Stojanovic, A.: *Differences in Bark Beetle* (*Ips typographus and Pityogenes chalcographus*) *Abundance in a Strict Spruce Reserve and the Surrounding Spruce Forests of Serbia.* In: Phytoparasitica **38** (2010), p. 31-37.
20. Mihalciuc, V., Chira, F., Chira, D., Voicescu, I., Oprean, I., Tautan, L., Ciupe, H., Pop, L., Botar, A.: *Testarea şi omologarea de noi feromoni pentru depistarea atacurilor şi combaterea unor dăunători ai răşinoaselor şi foioaselor.* In: Analele ICAS **43** (1995) No. 1, p. 135-145.
21. Mihalciuc, V., Bartiş, M., Navroţchi Vl.: *Eficacitatea capturării gândacului mic de scoarţă al molidului Pityogenes chalcographus L. la cursele amorsate cu feromon sintetic agregativ.* In: Revista Pădurilor **2** (1991), p. 83-86.
22. Novak, V., Hrozinka, F., Stary, B.: *Atlas of Insects Harmful to Forest Trees.* Volume 1. New York. Elsevier Scientific Publishing Company, 1976.
23. Pfeffer, A.: *Zentral - und westpaläarktische Borken - und Kernkäfer* (*Coleoptera: Scolytidae, Platypodidae*). Pro Entomologia, Naturhistorisches Museum Basel, 1995.
24. Postner, M.: *Scolytidae* (= *Ipidae*)*, Borkenkäfer.* In: Die Forstschädlinge Europas. Band 2. Schwenke, W. (Eds.), Parey, Berlin, 1974, p. 334-482.
25. Simionescu, A.: *Insecte care atacă între scoarţă şi lemn.* In: Protecţia pădurilor. Simionescu, A., Mihalache, Ghe. (Coord.). Editura Muşatinii, Suceava, 2000.
26. Wegensteiner, R., Lorbeer, E., Führer, E.: *Additional Attraction of Pityogenes chalcographus* (*L.*) (*Col., Scolytidae*) *to Chalcoprax-Baited Traps with Spruce Branches*. In: Journal of Applied Entomology **108** (1989), p. 250-259.
27. Zumr, V.: *Attractiveness of Introduced Conifers to Xylophagous Beetles and Their Acceptance.* In: J. Appl. Entomol. **113** (1992), p. 233-238.