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Comparison of two types of ECOLURE lure on *Ips typographus* (L.) (Coleoptera: Scolytidae)

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ABSTRACT: The efficiency of two types of pheromone dispensers (ECOLURE classic and ECOLURE tubus) was compared in 2008. Pheromone-baited traps were checked 13 times in 10-day intervals (this guaranteed the efficiency of ECOLURE tubus all time). ECOLURE classic trapped more beetles on average in all samples. Differences among the first 4 samples (checkings) were statistically insignificant, differences among another 9 samples were significant (used statistic tests – two choice *t*-test, $\alpha = 0.05$ from data with normal distribution, Wilcoxon matched pairs test in the case of other data distribution).

Keywords: ECOLURE; efficiency; *Ips typographus*; pheromone dispenser

Ips typographus is one of the most serious pests of spruce stands in Eurasia (Bakke 1989). Using trap trees has always been the basic tool of forest protection against this pest. In the last several decades pheromone traps have replaced trap trees in a massive way. The efficiency of pheromone traps as a measure of forest protection is still discussed by many authors (e.g. Dimitri et al. 1992; Lobinger, Skatulla 1996; Wichmann, Ravn 2001). It was calculated that using a high density of pheromone traps only 3-10% of the bark beetle population may be trapped (Weslien, Lindelöw 1990; Lobinger, Skatulla 1996). To ensure the right functionality of pheromone traps, the traps must be lured by pheromone dispenser. A key component of the bait is cis-verbenol (e.g. Jakuš, Blaženec 2002). But the number of trapped beetles is strongly dependent on many environmental factors and local conditions, such as temperature, sun exposure and others (Lobinger 1995). The type of used dispenser is a very important non-environmental factor. E.g. Zahradník et al. (1990) compared the efficiency of PHEROPRAX and IT ETOKAP. Jakuš and Šimko (2000) compared IT ECOLURE (with 6 different levels of release rates) and PHEROPRAX at pheromone trap barriers. The type of dispenser wrapper must allow a steady release of the effective quantity of pheromone active compounds for a long time. The type of this wrapper may play a significant role in the number of trapped beetles. The efficiency of 2 types of pheromone dispenser with the same chemical components packed to 2 different wrappers is compared in this paper (the first type is ECOLURE TUBUS, the second ECOLURE CLASSIC

MATERIAL AND METHODS

Investigated pheromone dispenser and aim of research

Two types of pheromone dispensers were investigated in this experiment. ECOLURE TUBUS guaranteed the efficiency of 18–20 weeks. Twenty weeks were considered as the time to compare the second type of lure – ECLURE CLASSIC (with the efficiency of 5 weeks after the first opening of

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wrapping bag, after the second larger opening of the same wrapping bag the efficiency is prolonged by another 7–10 weeks). IT ECOLURE CLASSIC (rank VYR IT 04 08·05) and IT ECOLURE TUBUS (rank 04·08··02) were used. Both are pheromone dispensers for *Ips typographus* compounded of (S)-cis-verbenol (3%), alcohols and solvents (85.2%) and synergic components (11.8%). ECOLURE CLASSIC contains 2.5 g of effective compounds and ECOLURE TUBUS 3 g. The basic difference between them is in the construction of the dispenser wrapper. Effective compounds are packed in a classic clipping bag in the case of ECOLURE CLASSIC, and in a special transparent plastic tube with free filling in the case of ECOLURE TUBUS.

Spatial experiment design

The study was conducted near the town of Písek (south Bohemia) in the Záhoří management-plan area located near the village of Záhoří (loc: 49°21'1"N, 14°12'1"E). Twenty pairs of pheromone traps of Theyson type were installed in the forest complex. Pheromone traps were located on clearcuts at distances of 15 m from the forest edge (according to the recommendation of the pheromone dispenser producer). A distance between traps in pairs was 70 m. Both traps in pair were always installed only on the linear forest edge (because of the same point of the compass). High weed growth was suppressed by herbicides 1.5 m around the trap. ECOLURE CLASSIC type of pheromone lure was put into the first pheromone trap in pair and ECOLURE TUBUS into the second one.

Timing experiment and measurement of trapped beetles

The time of comparative experiment was assessed according to the guaranteed time of ECOLURE TUBUS – it means 18–20 weeks (19 weeks were used).

Pheromone traps were installed on 13th April 2008 and they were lured by pheromone dispensers on 25th April. Traps were controlled every 10th day till the 3rd September.

The first bag with the efficient substance of ECOLURE CLASSIC was more opened by scissors on 1st June and replaced by the second one on 7th July. The second was more opened on 13th June and replaced by the third one on 16th July. The third one was more opened on 15th August and replaced by the fourth on 24th August, which was not more opened later.

The number of trapped beetles was always counted by means of a calibrated glass cylinder because it is assumed that 1 ml of eight-toothed spruce bark beetles is equal to 35 individuals.

Data analysis

STATISTICA 8.0 software was used for data analysis. Data normality was tested by Kolmogorov-Smirnov test. Significance of differences between the numbers of trapped beetles (between ECOLURE CLASSIC and ECOLURE TUBUS) was tested by t-test (dependent samples) in the case of normal data distribution and by Wilcoxon matched pairs test in the case of other data distribution. Differences in ten-day checkings and also in the total seasonal number of trapped beetles were tested.

Relative efficiency was calculated for single checking as the ratio of the number of trapped beetles by ECOLURE CLASSIC to the number of beetles trapped by ECOLURE TUBUS (C/T index).

Differences between C/T indexes were calculated as follows: C/T $\text{index}_{(\text{during checking } x)}$ divided by C/T $\text{index}_{(\text{during checking } x-1)}$.

RESULTS

Obtained data

During the whole tested period 418,151 individuals of *Ips typographus* were trapped to all 40 pheromone traps. 285,996 individuals were captured to the pheromone traps lured by ECOLURE CLASSIC and 132,155 individuals lured by ECOLURE TUBUS. It means that ECOLURE CLASSIC was 2.2 times more effective than ECOLURE TUBUS.

Summary data for all 20 pairs and for single checking are presented in Fig. 1. There are two obvious peaks of swarming – the first peak in spring (May 8th) and the second in summer (July 7th). There is one lower in between peak which represents the sister generation of spring swarming (Fig. 1).

Comparison of efficiency

Pheromone traps lured by ECOLURE CLASSIC captured a higher number of beetles than ECOLURE TUBUS during all checkings (from 1.1. to 36.6 times more – see the C/T index in Fig. 1). During spring swarming (checking on May 5th–June 7th)

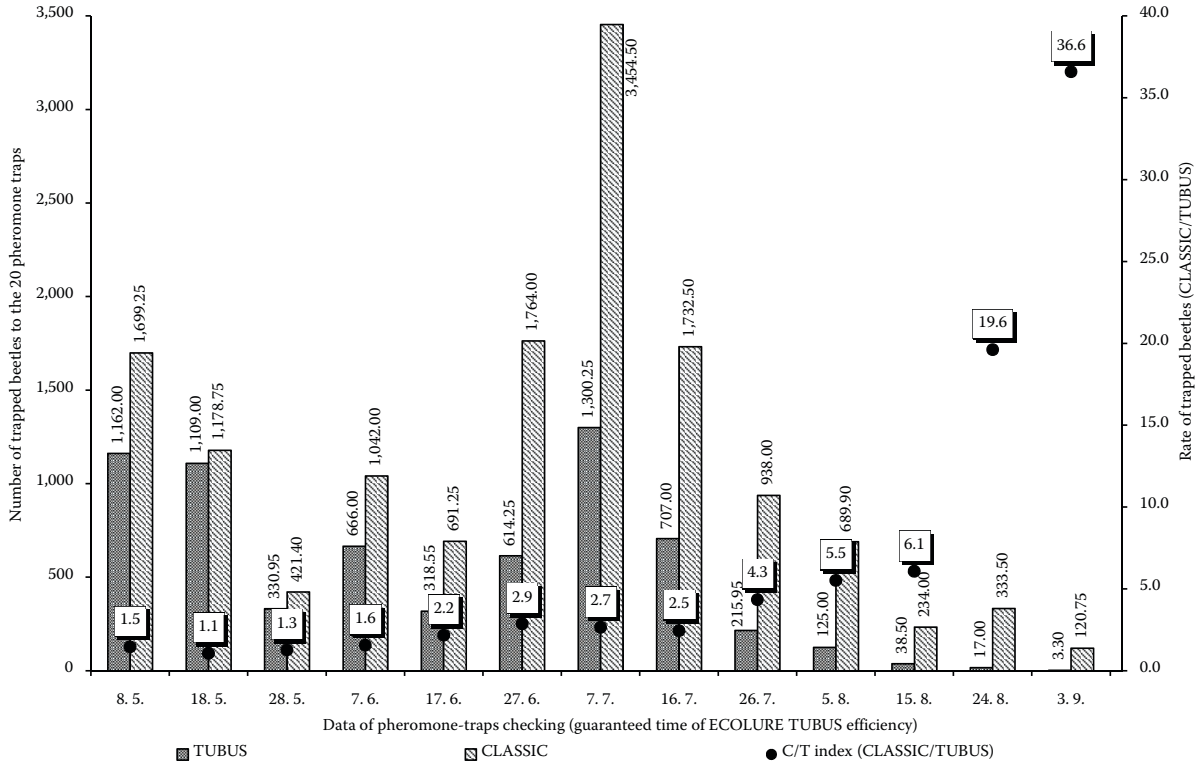

Fig. 1. Results of trapped beetles during all reference seasons. Guaranteed effective duration of ECOLURE TUBUS is represented on the *x*-axis – it is 18–20 weeks (19 weeks are on the *x*-axis in Fig. 1)

ECOLURE CLASSIC trapped 1.1–1.6 times more but the differences were not significant (α = 0.05) – Table 1. From this aspect possible efficiency of both lures can be considered the same in this period. Then the relative efficiency of ECOLURE CLASSIC increases.

During the second swarming (June 17th to September 3rd) the relative efficiency of ECOLURE CLASSIC increased from 2.2 to 36.6. After 1.5 month ECOLURE CLASSIC trapped twice more beetles, more than 4 times more after 3 months and more than 20 times more after 4 months. Differences between

Table 1. Parameters of statistical analysis for each sample

Checking	Data normality (Kolmogorov-Smirnov test)	Used test	*P*-values	Statistical significance of differences (α = 0.05)
8.5.	no	WT	0.06461	NS
18.5.	no	WT	0.58694	NS
28.5.	yes	TT	0.54661	NS
7.6.	no	WT	0.10843	NS
17.6.	no	WT	0.00009	S
27.6.	yes	TT	0.00004	S
7.7.	no	WT	0.00009	S
16.7.	no	WT	0.00009	S
26.7.	no	WT	0.00024	S
5.8.	no	WT	0.00010	S
15.8.	no	WT	0.00009	S
24.8.	no	WT	0.00009	S
3.9.	no	WT	0.00009	S

TT – *t*-test for dependent samples, WT – Wilcoxon matched pairs test, S – significant, NS – not significant

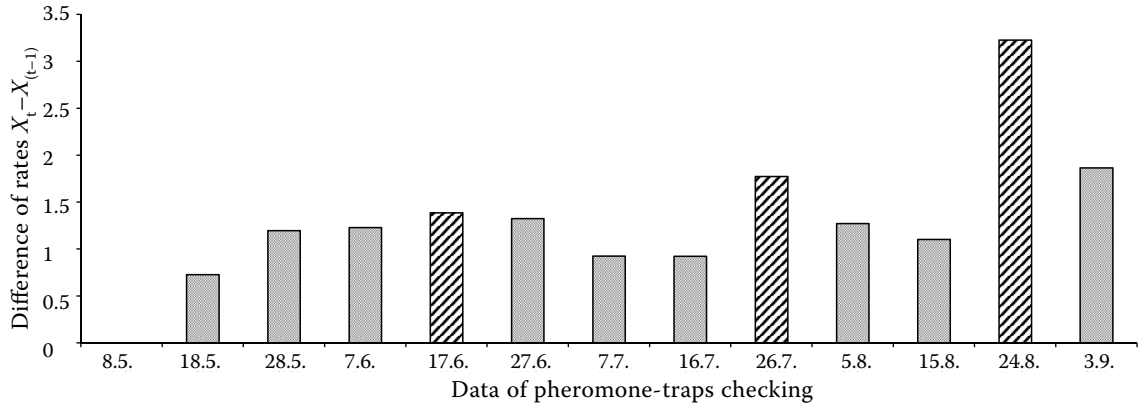

Fig. 2. Differences between C/T indexes (calculated as follows: C/T index $_{\text{(during checking } x\text{)}}$ divided by C/T $_{\text{index (during checking } x-1\text{)}}$))

the numbers of trapped beetles during the second swarming are statistically significant ($\alpha = 0.05$).

Statistical evaluation of all checkings including *P*-values is presented in Table 1.

The ratios of C/T indices are shown in Fig. 2. This graph illustrates 3 peaks on June 7th, July 26th and August 24th (the columns are highlighted by shading in Fig. 2). These peaks represent successive checkings after partly opening the bag of ECOLURE CLASSIC. It means that the efficiency of ECOLURE CLASSIC suddenly increases and that is the reason why the C/T index is higher. This phenomenon is much more visible in the ratios of 2 subsequent C/T indices. Furthermore, the efficiency of ECOLURE CLASSIC gradually decreases and that is why the value of the C/T index also decreases until the bag of ECOLURE CLASSIC is partly opened again. As the efficiency of ECOLURE TUBUS gradually decreases, the C/T index increases after opening the bag (Fig. 1) at the end of the season.

DISCUSSION

Two generations per year were recorded during the survey season. This is common in Central Europe, except for higher elevations (Wermelinger, Seifert 1999). Our results show that ECOLURE TUBUS is not a suitable pheromone dispenser in comparison with ECOLURE CLASSIC in common forestry conditions. ECOLURE TUBUS traps lower the amount of beetles. It closely corresponds with the lower level of pheromone released to the environment (immediately after the beginning of the season). On the other hand, the lower release of pheromone from ECOLURE TUBUS may have an influence on the (increasing) male percentage in samples (Schlyter et al. 1987; Jakuš, Šimko 2000). The question is if the increased number of males at a lower amount of beetles (in the case of ECOLURE TUBUS) may compensate the decreased percentage of males at a high amount of trapped beetles in the case of ECOLURE CLASSIC. Jakuš and Šimko (2000) showed that a decrease in pheromone release to 50% led to a decrease in the total amount to 87% for IT ECOLURE. It may mean that pheromone release was decreased by more than 50% after the 4th sample (in comparison with ECOLURE CLASSIC) and by the end of the season the bag with ECOLURE TUBUS was almost without pheromone.

The use of ECOLURE TUBUS can be recommended for extreme topological conditions where traps are without easy access (e.g. steep slopes, distant fields etc). In these cases we assume a very long interval between checkings and that is why we may expect decreasing efficiency of ECOLURE TUBUS by following way. Kretschmer (1990) reported a strong decreasing influence on the number of dead beetles in pheromone traps. This phenomenon is caused by the emission of 1-hexanol and verbenone from dead beetle bodies (Zhang et al. 2003).

CONCLUSION

In this study the efficiency of 2 types of pheromone dispensers was compared (ECOLURE CLASSIC and ECOLURE TUBUS). Both lures contain the same chemical components, but they have a different way of packing. ECOLURE CLASSIC always trapped more beetles than ECOLURE TUBUS during all beetle activity. Statistical differences in the number of trapped beetles were insignificant during the first swarming (the first 40 days) and then significant (next 90 days). This statistical significance of differences still increased during the 90 days. At the end of the guaranteed efficiency

of ECOLURE TUBUS this lure trapped the 36.6 times lower number of beetles in comparison with ECOLURE CLASSIC.

We show that the wrapper of the dispenser is similarly important like the efficiency of compounds inside.

References

Bakke, A. (1989): The recent Ips typographus outbreak in Norway: Experiences from a control program. Holarctic Ecology, ***12***: 515–519.

Dimitri L., Gebauer U., Lösekrug R., Vaupel O. (1992): Influence of mass trapping on the population dynamic and damage-effect of bark beetles. Journal of Applied Entomology, ***114***: 103–109.

Jakuš R., Blaženec M. (2002): Influence of proportion of (4S)-cisverbenol in pheromone bait on *Ips typographus* (Col., Scolytidae) catch in pheromone trap barrier and in single traps. Journal of Applied Entomology, ***126***: 306–311.

Jakuš R., Šimko J. (2000): The use of dispensers with different release rates at pheromone trap barriers for *Ips typographus*. Journal of Pest Science, ***73***: 33–36.

Kretschmer K. (1990): The effect of carrion smell on the catching-efficiency of spruce bark beetle traps. Anzeiger für Schädlingskunde, Pflanzenschutz, Umweltschutz, ***63***: 46–48.

Lobinger G., Skatulla U. (1996): Untersuchungen zum Einfluss von Sonnenlicht auf das Schwärmverhalten von Borkenkäfern. Anzeiger für Schädlingskunde, Pflanzenschutz, Umweltschutz, ***69***: 183–185.

Schlyter F., Byers J.A., Löfquist J. (1987): Attraction to pheromone sources of different quantity, quality and spacing: Density-regulation mechanisms in bark beetle *Ips typographus*. Journal of Chemical Ecology, ***13***: 1503–1523.

Wermelinger B., Seifert M. (1999): Temperature-dependent reproduction of the spruce bark beetle *Ips typographus*, and analysis of the potential population growth. Ecological Entomology, ***24***: 103–110.

Weslien J., Lindelöw Å. (1990): Recapture of marked spruce bark beetles (*Ips typographus*) in pheromone traps using area-wide mass trapping. Canadian Journal of Forest Research, ***20***: 1786–1790.

Wichmann L., Ravn H.P. (2001): The spread of *Ips typographus* (L.) (Coleoptera, Scolytidae) attacks following heavy windthrow in Denmark, analyzed using GIS. Forest Ecology and Management, ***148***: 31–39.

Zahradník P., Knížek M., Kapitola P., Rodziewicz A., Kolk A. (1990): Comparison of efficiency common types of pheromone dispensers on *Ips typographus* trapping (*Ips typographus* L.). Zprávy lesnického výzkumu, ***35***: 23–27.

Zhang Q.-H., Jakuš R., Schlyter F., Birgersson G. (2003): Can *Ips typographus* (L.) (Col., Scolytidae) smell the carrion odours of the dead beetles in pheromone traps? Electrophysiological analysis. Journal of Applied Entomology, ***127***: 185–188.

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