New Lure for the Larger Pine Shoot Beetle, *Tomicus piniperda* — Attractant/Trap Design Combinations Tested in North America and Europe

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Abstract

An optimized, patented lure for the larger pine shoot beetle, *Tomicus piniperda* has been developed and tested in the United States, Poland, and Croatia. Seven different beetle attractants were tested: α-pinene, α-pinene oxide, ethanol, nonanal, myrtenal, myrtenol, and *trans*-verbenol. α-pinene was tested alone or in combination with two or more of the remaining compounds. Attraction of all candidate lures was compared to attraction of Tomodor, a Polish commercial lure for *T. piniperda*, using the Intercept™ Panel Trap (PT). A lure containing α-pinene, α-pinene oxide, nonanal, myrtenal, myrtenol, and *trans*-verbenol was used to compare trap captures in Intercept PT with 12-unit multi-funnel traps in USA, Theyson trap in Croatia, and IBL-3 trap in Poland. This study demonstrated that at least a quaternary semiochemical combination, including α-pinene, nonanal, *trans*-verbenol, and myrtenol is required to assure maximum trap captures. The best IPM Tech lure was significantly more attractive than Tomodor when tested in Poland and Croatia. Catches of *T. piniperda* in the Intercept PT were significantly higher than in the IBL-3 trap or Theyson trap.

Keywords: larger pine shoot beetle, *Tomicus piniperda*, attractant, Intercept Panel Trap (PT), insect monitoring

Introduction

The larger pine shoot beetle, *Tomicus piniperda,* is native to Europe and Asia. In 1992, *T. piniperda* was discovered in the United States (Haack et al. 1997). Czokajlo et al. (1996) demonstrated that the beetle had been introduced to North America as early as the late 1970s or early 1980s. Since then, *T. piniperda* has spread through 12 USA states and two Canadian provinces (NAPIS 2002). The chemical ecology of *T. piniperda* is not well understood, and consequently, this pest is difficult to monitor and manage. Presently in North America, only α-pinene is used as a commercial lure (Phero Tech, Inc., Delta, BC, Canada). In Europe, Tomodor (Z.D. Chemipan, Poland) and Tomowit (Bio/Technik/Chemie WITASEK, Austria) are the only known commercially available lures, however none of these lures attract a satisfactory number of beetles. Several trap designs are used for monitoring beetle populations. The multi-funnel trap (Phero Tech, Inc., Delta, BC, Canada) has been the most common trap design used in North America. Several other trap designs have been used in Europe and Asia, e.g. Theyson trap, drain-pipe trap, barrier traps, and multi-funnel trap. Forest managers and land owners need an effective *T. piniperda* monitoring system.

IPM Tech has developed an improved lure for the larger pine shoot beetle based on previous research (Czokajlo 1998, Czokajlo and Teale 1999, Teale et al. 2001) and unpublished field results. The main objective of this study was to validate an optimal blend and optimal release rates of semiochemicals, along with field test trap designs in order to determine the most effective system for trapping *T. piniperda* during its reproductive flight in spring.

Figure 1.—Intercept PT (left), Multi-funnel trap (center), IBL-3 trap (top right), Theyson trap (bottom right).

Materials and Methods

Experiments were conducted in the United States, Poland, and Croatia in the spring of 2002. In the United States, the experiment was conducted in an isolated (5 ha), unmanaged, 50-year-old Scots pine stand near Syracuse, NY. In Croatia, the experiment was conducted in a mixed 90% *Pinus sylvestris*, 10% *P. nigra* uneven age (40 to 80-year-old) forest. In Poland, the experiment was conducted in a 65-year-old, even-aged Scots pine forest near Suprasl.

Beetles were caught in Intercept™ Panel Trap (Int PT, IPM Tech, Inc., Portland, OR, USA) and in: 12 unit multi-funnel trap in the United States, IBL-3 funnel trap in Poland, and Theyson trap in Croatia (Fig. 1). Traps were spaced at 15 m or more, with the collection cup or container about 30 cm above the ground. The chemicals used were: α-pinene (Berje, Inc., 98%), α-pinene oxide (Elf-Atochem, 96%), ethanol (Aaper Alcohol and Chemicals, Co., 100%), nonanal (Polarome, 98%), myrtenal (Aldrich, 98%), myrtenol (Aldrich 98%), and *trans*-verbenol (IPM Tech, Inc., 99%). The compounds were released separately and combined into mesh bags for different treatments (Fig 2). Lure combinations, release dispensers and rates of release are provided in Table 1. There were eight treatments in the US experiment and seven treatments in Poland and Croatia. Each treatment was replicated ten times. Beetles were collected weekly.

The field data were subjected to a single factor ANOVA. Trap catches from the United States were log transformed and trap catches from Croatia were square root transformed to satisfy ANOVA assumptions. The HSD test was used to compare means in Poland and LSD test was used to compare means in Croatia and in the United States (Stat Soft, Inc., 1995).

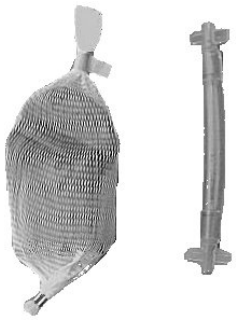

Figure 2.—*Tomicus piniperda* IPM Tech's lure (left) and Tomodor (right).

Table 1.—Candidate semiochemicals for *Tomicus piniperda*.

Common Name	Abbreviation	Release device	Release rate (mg/24h)	Treatment*
α-Pinene	α-P	2 LDPE bulbs	300	A,B,C,D,E,F
α-Pinene Oxide	α-P-ox	2 LDPE vials	4	D,E
Nonanal	N	2 LDPE vials	16	B,C,D,E,F
(-) Myrtenal	M-al	LDPE pouch	12	C,D,E
trans-Verbenol	t-V	LDPE pouch	4	B,C,D,E,F
(-) Myrtenol	M-ol	LDPE pouch	4	B,C,D,E
Ethanol	E	LDPE pouch	70	E
Tomodor				Tomodor

* Treatment D was used to compare captures in Intercept PT, Theyson trap, and Multi-funnel trap.

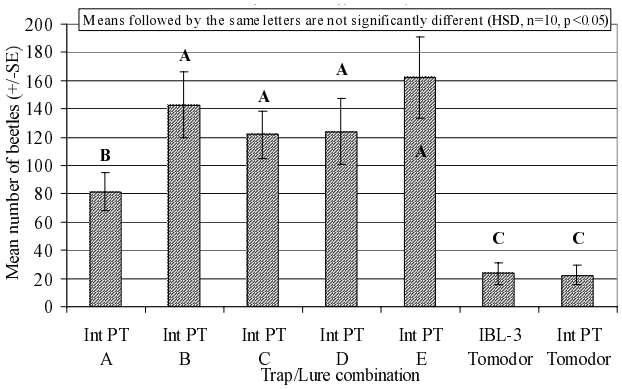

Figure 3.—Captures of *Tomicus piniperda* in Intercept PT and IBL-3 traps baited with various IPM Tech lure combinations and Tomodor (Polish lure) Poland, 2002.

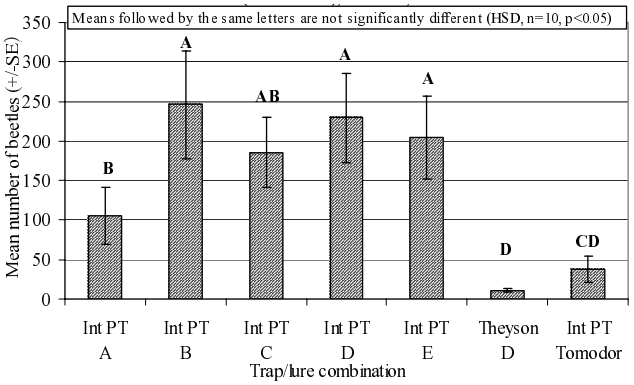

Figure 4.—Trap captures of *Tomicus piniperda* in INT PT and Theyson traps baited with various IPM Tech lures and Tomodor (Polish lure) Croatia, 2002.

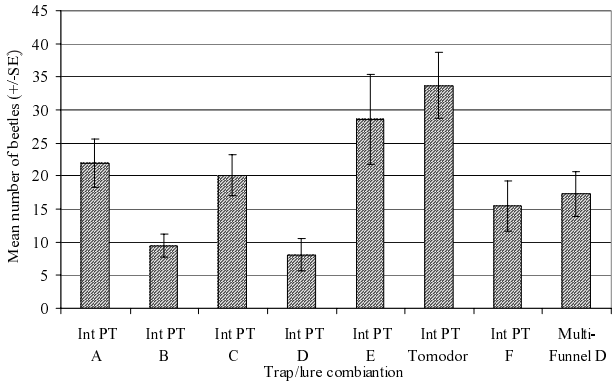

Figure 5.—Trap captures of *Tomicus piniperda* in INT PT and Multi-funnel traps baited with various IPM Tech lures and Tomodor (Polish lure) near Syracuse, NY, USA, 2002.

Results

The best IPM Tech lure was significantly more attractive than Tomodor and α-pinene lures when tested in Poland (Fig. 3) and Croatia (Fig. 4). Data from the United States was inconclusive (Fig. 5). In Poland, IPM Tech's best lure attracted 638% more beetles than Tomodor and 176% more beetles than α-pinene. In Croatia, the best IPM Tech lure attracted 650% more beetles than Tomodor and 233% more beetles than α-pinene. In the United States, captures in traps baited with the best IPM Tech lure, Tomodor, or α-pinene were not different. However, the data collected in the United States was probably inconclusive because in 2002, the reproductive flight of *T. piniperda* occurred unusually late in the spring and was extended over a period of several weeks; in addition, population levels were unusually low. Also, in Poland and Croatia, the Tomodor lure attracted significantly fewer beetles than α-pinene (by 363% and 278%, respectively); however this was not the case in the United States. Captures of *T. piniperda* in Intercept PT in Croatia were significantly higher than in the Theyson trap (by 216%).

Conclusions

The new IPM Tech trap (Intercept PT) and lure for *T. piniperda* proved to be superior to those used commercially in Europe. IPM Tech's lure for *T. piniperda* performs better than commercially available European lures and better than the α-pinene lures used in the United States. Our research indicates that at least a quaternary semiochemical combination, including α-pinene, nonanal, *trans*-verbenol, and myrtenol is required to assure maximum trap captures. Further, IPM Tech's Intercept PT proved to be the best trap compared to any of the European trap designs tested in this study.

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