FIELD TRIAL OF LIQUID PHEROMONE CAPSULE (GALLOPRO PINOWIT®) AGAINST BARK BEETLES IN İSTANBUL (TURKEY) FORESTS

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Abstract. This study has been done in the pine forests, located in Çamlık within Çatalca Forest Management's (İstanbul-Turkey) Silivri Forestry Department, in 2018. The purpose of the study was to investigate biological efficacy of GALLOPRO PINOWIT® commercial pheromone product against *Monochamus galloprovincialis* (Olivier), *Ips sexdentatus* (Boerner), *Orthotomicus erosus* (Wollaston) and *Hylurgus ligniperda* (Fabricius) insect pests on the field. In the study, Scandinavian three funnel traps were used and SMC-ORTIR, TRIPHERON-IPSSEX and TRIPHERON-ORTERO pheromone preparations were used as comparison products. For the evaluation of collected insects count data, two-way ANOVA analysis has been used, variance between preparations-insect counts have been investigated using t test and activity of each preparation has been designated as %. According to the results obtained, it can be concluded that Gallopro Pinowit® preparation can be effectively used against pest insects *Ips sexdentatus, Orthotomicus erosus, Tomicus sp.* and *Monochamus galloprovincialis* which cause serious damage to coniferous trees.
Keywords: *pheromone, Scolytidae, pine forests, Çamlık, Silivri, biotechnical, Scandinavian type three-funnel trap*

Introduction

Insect pests are undoubtedly an important factor threatening sustainability of forests and forestry products. According to FAO's 2010 data, almost 35 million ha of forest area is being devastated by forest pests every year (Yalçın et al., 2016).

Bark beetles (*Scolytidae*) have an important place among forest pests. Many researchers, local and foreign (Defne, 1954; Can, 1964; Ekici, 1971; Sekendiz,1974; Hakyemez et al., 2013; Serez,1986, 1987; Öymen,1989; Pfeffer,1995; Selmi,1998; Oğurlu, 2000; Faccoli, 2004; Kanat and Laz, 2005; Sarıkaya, 2008; Wong et al., 2017) carried out studies on bark beetles and provided information regarding status of bark beetles in Turkey's forests. During some years, those insects can even cause great economic loss by reproducing in mass under appropriate conditions.

Pheromones are a biotechnical method which is used effectively against bark beetles damaging and causing great losses in forests. Pheromone is a sort of odor, released by both male and female insects to find their mates. Each species has a pheromone to communicate with each other (Galko et al., 2016; Straw et al., 2013). The case of monogamous insects, females, and in polygamous insects, both sexes release these pheromones. The pheromone which is used to communicate among the same species is called "Allomone" while pheromone released by different species is called "Kairomone" (Serez, 1987).

In other terms, pheromones are released by an individual insect and have an effect on behavior of the same species (Coulson and Witter, 1984).

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Pheromones are species-specific. This property brought forward the idea of collecting insects in mass and then exterminate them. They can be synthetically produced and can be used to capture insect pests with special traps (Baker, 2008).

Pheromones do not have any negative impact on beneficial life forms, such as parasites and predators, honey bees, vertebrates and humans. For that reason, its area of usage is expanding every year. Primary reason of emergence of pheromone traps is their ability neutralize pests without disturbing the natural equilibrium with ease (Küçükosmanoğlu and Arslangündoğdu, 2002).

Use of pheromones play an important role in controlling bark beetle population in recent years. Consequently, it is imperative to investigate efficacies of pheromones manufactured by various companies and that consumers then use those successful products in controlling insects.

In forests (Turkey), pheromone traps started to be used in 1982 and their usage increased exponentially since then. Considerable results have been obtained against bark beetles with this method (Serez, 1987).

Applications of this method are constantly increasing in the recent years. It has been stated that in the 40,000 pheromone traps set up by Ministry of Forestry of Turkey, an average of 100 million pest insects are captured every year. Those captured insects are both exterminated and used as feed for the predator insects grown specifically for biological combat (Yalçın et al., 2016).

Hundreds of pheromones have been discovered that are used to monitor the presence and abundance of insects and to protect plants and animals against insects. Pheromones are increasingly efficient at low population densities, they do not adversely affect natural enemies, and they can, therefore, bring about a long term reduction in insect populations that cannot be accomplished with conventional insecticides (Witzgall et al., 2010).

Insecticides do not achieve a long-term pest population decrease. In contrast, an observation shared by many working with pheromone-based control is that continuous long-term use does decrease population levels of target species (Ioriatti et al., 2008; Weddle et al., 2009).

This stud has been done to determine efficacy of Gallopro Pinowit® pheromone which contains Ipsdienol (1.6%), Ipsenol (1.9%), Alphapinene (47.7%) and Ethanol (48.8%) and used against *Monochamus galloprovincialis*, *Ips sexdantatus*, *Orthotomicus erosus* and *Hylurgus ligniperda*, in the pests' target pine forest area between 04.05.2018 and 28.08.2018.

Gallopro Pinowit is a newly produced pheromone. Therefore it has been the subject of our study.

Materials and methods

In order to determine the field for trials and evaluating presence of target pest population, appraisal tours have been done in the pine forest which is under Istanbul (Turkey) Regional Forestry Directorate's supervision, with the help and support of Department of Combatting Forests Pests. Previous years' reports have been considered and pine stands in Çamlık, Çatalca Forestry Department – Silivri Forest Department have been selected as the trial area (*Fig. 1*).

There are 20-25 years old *Pinus maritima* (Maritime Pine), *P. nigra* (Black pine) and *P. pinea* (Stone pine) trees (*Fig. 2*). The elevation of the study area ranges from 117 to 176 m above sea level (a.s.l.). In this study, 24 funnel type traps (*Fig. 1*), L shaped

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wooden stakes to fix on the ground and pheromone preparations (GALLOPRO-PINOWIT, SMC-ORTIR, TRIPHERON-IPSSEX, TRIPHERON-ORTERO) have been used (*Table 1*). Funnel type trap is preferred for most often used in Turkey (*Fig. 3*).

The location coordinates of the traps has been included in *Table 1* data.

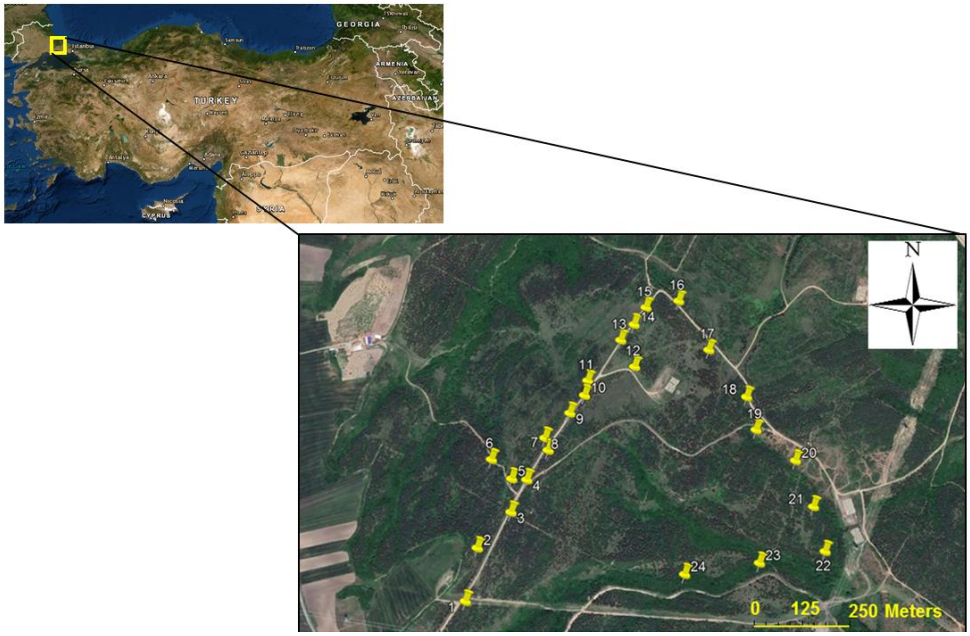

Figure 1. *The locations where Funnel type traps were established*

Figure 2. *The view from the working area*

GalloPro Pinowit® (Liquid)

Content:	Ipsdienol (1.6%), Ipsenol (1.9%), Alphapinene (47.7%) ve Ethanol (48.8%)
Production:	June -2017
Code:	86-292
Manufacturer:	Witasek PflanzenSchutz GmbH, Mozartsraβe 1a, 9560 Feldkirchen, Austria

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SMC ORTIR® (Liquid)

Content:	Ipsidenol (25 mg), 2-methly-3 buten-2-ol (1500 mg), Cis-Verbenol (80 mg)
Registration:	5525/18.05.2006
Production:	Jan-2018
Lot No:	115-50-1
Manufacturer:	ChemTica Internacional S.A., P.O. Box 40301, Santo Domingo, Costa Rica

Tripheron IPSSEX® (Granule)

Content:	Ipsdienol (105 mg)
Registration:	1/14.12.2001
Production:	Feb-2018
Lot No:	540-621-1
Manufacturer:	Trifolio-M GmbH, Dr Hans Wilhelmi-Weg 1, 35633 Lahnau, Germany

Tripheron ORTERO® (Granule)

Content:	Ipsdienol (30 mg), Metil-butenol (1500 mg), Cis-Verbenol (100 mg)
Registration:	3/14.12.2001
Production:	Feb-2018
Lot No:	540-624-1
Manufacturer:	Trifolio-M GmbH, Dr Hans Wilhelmi-Weg 1, 35633 Lahnau, Germany

Figure 3. *Funnel type trap*

One week after the traps were placed, captured insects were gathered from each trap, placed inside jars and brought to the lab and counted on petri dishes. For the evaluation of collected insects count data, two-way ANOVA analysis has been used, variance

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between preparations-insect counts have been investigated using t test and activity of each preparation has been designated as %. Trial area's dense population of target insects (*I. sexdentatus*, *O. erosus*, *T. destruens*, *T. minor*, *T. piniperda*, *M. galloprovincialis*) and collected insect amounts were noted. Total number of *Tomicus* species has been included to the table data.

The months in the study were not considered as a factor. Because the working time does not include all months.

Table 1. *Trap locations and their contents*

Trap #	Preparation	Coordinates		Elevation
		N	E	M
1	Gallopro Pinowit	41°09'18"	28°03'00"	176
2	SMC ORTIR	41°09'28"	28°03'05"	176
3	Tripheron IPSSEX	41°09'27"	28°03'06"	176
4	Tripheron ORTERO	41°09'30"	28°03'08"	167
5	Gallopro Pinowit	41°09'30"	28°03'06"	176
6	Tripheron IPSSEX	41°09'32"	28°03'03"	159
7	Gallopro Pinowit	41°09'33"	28°03'11"	167
8	SMC ORTIR	41°09'33"	28°03'11"	167
9	Tripheron IPSSEX	41°09'37"	28°03'14"	167
10	Tripheron ORTERO	41°09'39"	28°03'16"	167
11	Gallopro Pinowit	41°09'42"	28°03'20"	176
12	Tripheron IPSSEX	41°09'42"	28°03'23"	176
13	SMC ORTIR	41°09'45"	28°03'21"	167
14	Gallopro Pinowit	41°09'46"	28°03'23"	167
15	Tripheron IPSSEX	41°09'46"	28°03'23"	167
16	Tripheron ORTERO	41°09'48"	28°03'30"	167
17	Gallopro Pinowit	41°09'45"	28°03'34"	159
18	Tripheron IPSSEX	41°09'42"	28°03'38"	159
19	Gallopro Pinowit	41°09'39"	28°03'40"	150
20	SMC ORTIR	41°09'39"	28°03'40"	150
21	Gallopro Pinowit	41°09'35"	28°03'43"	142
22	Tripheron IPSSEX	41°09'33"	28°03'48"	134
23	Tripheron ORTERO	41°09'29"	28°03'53"	117
24	Tripheron IPSSEX	41°09'25"	28°03'55"	117

During trials, except Gallopro Pinowit, all other preparations have been renewed on 29.06.2018. According to instruction guidelines, Gallopro Pinowit keeps its activity for 18-20 weeks, therefore during trials we have also tested its durability in field.

Results and discussion

Identified species on pheromone traps in the trial area were mostly; *Ips sexdentatus*, *Orthotomicus erosus*, *Tomicus destruens*, *Tomicus minor*, *Tomicus piniperda* and *Monochamus galloprovincialis*. Apart from those, many Coleoptera species (pest or predators) were found in the pheromone traps.

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Gallopro Pinowit® had the most captures. Additionally, during rainy days while other pheromone preparations had their performances decreased, however, Gallopro Pinowit® preparation continued to work without being affected.

Counts during field application of pheromone preparations, statistical processes and evaluations after that has been shown in detail in *Tables 2, 3* and *4*.

No phyto-toxicological effects have been detected on trees of the site during field trials.

When preparations were compared, Gallopro Pinowit's attractivity was found to be: *I. sexdentatus* 20.27%, *O. erosus* 2.52%, *Tomicus sp.* 88% and *M. galloprovincialis* 80%. SMC ORTIR's attractivity for the same species, respectively 21.43%, 56.34%, 3.77% and 10.31%; Tripheron IPSSEX's attractivity, respectively 39.87%, 4.74%, 4.55% and 7.85%; Tripheron ORTERO's attractivity, respectively 18.43%, 36.40%, 3.68% and 1.84%. The results indicate, unlike other dispensers which have been renewed (29.06.2018), Gallopro Pinowit's performance still exhibited sufficient insect attractivity throughout trial period (which can also be seen from the ratios) as indicated on the usage instructions.

This assessment also conforms with the results of variance analysis and from dispensers' attractivity and count of insect species aspect, there is an important difference of $p = 0.001$ between. With regards to attracting pest insects, preparations had no difference of $p = 0.05$ meaning all dispensers have attracted more or less respectively.

Table 2. *Captured insects throughout the trials*

		Preparations				
		Gallopro Pinowit	**SMC ORTIR**	**Tripheron IPSSEX**	**Tripheron ORTERO**	**Totals**
Ips sexdentatus	May	37	14	270	59	**380**
	June	174	145	85	109	**513**
	July	25	85	123	48	**281**
	August	7	13	0	5	**25**
Orthotomicus erosus	May	233	5091	423	3499	**9246**
	June	87	2043	176	981	**3287**
	July	23	380	67	506	**976**
	August	12	416	1	135	**564**
Tomicus sp.	May	1271	40	108	81	**1500**
	June	1180	60	47	43	**1330**
	July	311	29	32	20	**392**
	August	850	26	0	7	**883**
Monochamus galloprovincialis	May	124	3	18	6	**151**
	June	426	76	4	5	**511**
	July	79	5	42	4	**130**
	August	23	0	0	0	**23**
Totals		**4862**	**8426**	**1396**	**5508**	**20192**

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Table 3. *Comparison results of insect species and dispensers with two-way ANOVA analysis*

Source of variance (source)	Degree of freedom (df)	Sum of squares (SS)	Mean squares (MS)	F	P
Preparation	3	1561936.5	520645.5	1.55	P > 0.05
Insect	3	7191860.3	2397287.0	7.14	P < 0.002
Pheromone x insect	9	17158127.8	1906459.0	5.67	P < 0.001
Error	48	16126461.0	335967.9		
Total	63	42038386.0			

Table 4. *In and in-between dispensers trap capture ratios (%) during trial period*

		Gallopro Pinowit	SMC ORTIR	Tripheron IPSSEX	Tripheron ORTERO
Ips sexdentatus	In-between dispensers	20.27	21.43	39.87	18.43
	In dispensers	5	3.05	34.24	4.01
Orthotomicus erosus	In-between dispensers	2.52	56.34	4.74	36.4
	In dispensers	7.3	94.11	47.78	92.98
Tomicus sp.	In-between dispensers	88	3.77	4.55	3.68
	In dispensers	74.29	1.84	13.4	2.74
Monochamus galloprovincialis	In-between dispensers	80	10.31	7.85	1.84
	In dispensers	13.41	1	4.58	0.27

Conclusions

As a result, field trial and counts clearly show that pheromone preparation, commercially known as, Gallopro Pinowit® can be effectively used against *Ips sexdentatus*, *Orthotomicus erosus*, *Tomicus sp*. and *Monochamus galloprovincialis*, important pests of coniferous trees.

Pheromones are indeed elegant and safe tools for insect control. The fascination of being able to control insect populations through species-specific manipulation of sexual communication, without adversely affecting other, beneficial organisms, has been a driving force for research on insect pheromones during four decades.

The importance of pheromone-based methods is accentuated in view of increasing problems associated with the use of conventional insecticides. However, for a more widespread use of pheromones, application techniques must become more reliable and more economic. The key to further development is closer communication and

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collaboration between academic research institutions, plant protection industry and extension services (Witzgall, 2001).

Use of pheromones for controlling pest population has significant advantages over chemical treatments to humans, to environment and to other life forms by not harming those. For that reason, beside taking preventive measures, greater success will be achieved when field-tested and proven biologically efficient pheromone preparations are used in controlling bark beetle population.

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