Pheromones for Insect Control in Orchards and Vineyards
IOBC wprs Bulletin Vol. 24(2) 2001
pp. 89-93

Successful control of *Sparganothis pilleriana* (Lepidoptera: Tortricidae) by mating disruption - Conclusions from a three-year study

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Abstract: Mating disruption using sex pheromones was tested for control of *Sparganothis pilleriana* Schiff., a tortricid moth causing occasional but serious damage to grapevines. Chemical control is often inefficient due to the particular life habits of the larvae. Disruption of sexual communication in *S. pilleriana* was investigated as alternative, environmental friendly control method. Based on the mixture of the main pheromone compound of *S. pilleriana* (E9-12Ac) and of *Eupoecilia ambiguella* (Z9-12Ac), four blend compositions were tested in the vineyard. A blend of E9-12Ac, Z9-12Ac, Z11-14Ac, E9-12OH, Z9-12OH was most effective and reduced the larval infestation rate of *S. pilleriana* by 80 to 98%. Infestation of *E. ambiguella* was decreased by 40 and 50%. A combined control of these two grape tortricids is discussed.

Keywords: mating disruption, sex pheromone, viticulture, *Sparganothis pilleriana*, *Eupoecilia ambiguella*, Tortricidae, Lepidoptera

Introduction

Increasing population densities of *Sparganothis pilleriana* Schiff., a tortricid grapevine pest of worldwide distribution, has been observed in the South Palatinate (Germany) since the early 1990´s (Schirra & Louis 1995). The larvae may cause high economic damage by feeding on shoot tips, leaves, inflorescences and grape bunches. The effectiveness of common insecticides in reducing the infestation rate is often unsatisfactory. The poor performance of insecticides is likely due to the life habits of this tortricid. For example, the overwintering first instar larvae migrate over a period of six weeks from under the bark of the vine in spring. In addition, the larvae hide in shoot tips and build feeding shelters out of leaves. These habits make it extremely difficult to accurately time applications of insecticide and for insecticides to contact the larvae.

In 1996, a research project was launched at the Federal Education and Research Institute Neustadt/Weinstraße, Germany, with the goal of finding an effective and environmental safe method to control *S. pilleriana*. A major objective was to examine the potential of mating disruption using sex pheromones against this pest. Saglio *et al*. (1977), Roehrich (1977) and Guerin *et al*. (1986) demonstrated that E-9-dodecenyl acetate (E9-12Ac), E-9-dodecen-1-ol

(E9-12OH), E-11-tetradecenyl acetate (E11-14Ac) and Z-11-tetradecenylacetat (Z11-14Ac) play a role in sexual communication of *S. pilleriana* moths. Another objective was to determine if *Eupoecilia ambiguella* Hbn., another important vine pest, could be concurrently controlled by mating disruption. For this reason we added the main sex pheromone component of this tortricid, Z-9-dodecenyl acetate (Z9-12Ac) (Arn *et al*. 1976), to the mixtures of components, we tested for mating disruption of *S. pilleriana.*

Materials and Methods

The experiments conducted from 1996 and 1997 and the experimental design used in 1998 are described by Schmidt-Tiedemann *et al*. (1999a, b). In 1998 two 5 ha sites were treated with a 70:70:60:4:1 blend of E9-12Ac, Z9-12Ac, Z11-14Ac, E9-12OH and Z9-12OH (Blend 1, relative amounts). The blend was formulated in polyethylene tube dispensers (Shin-Etsu Chemical Company, Ltd. Tokyo, Japan) with 85 mg of the blend per dispenser. The plots were treated with 1000 dispensers/ha without an additional border treatment. The effectiveness of the treatment was monitored with pheromone-baited traps (for *S. pilleriana* and *E. ambiguella*) and traps baited with a virgin female (for *S. pilleriana*) (Table 1 and 2). The traps and lures used for *S. pilleriana* are described in Schmidt-Tiedemann *et al*. (1999b). Tetra traps from Hoechst AG, Frankfurt, Germany, were used for *E. ambiguella*. The pheromone-baited traps for *S. pilleriana* were arranged in groups of three within the pheromone plot (9 traps at site 1; 12 traps at site 2) and within untreated plots (9 traps at site 1; 9 traps at control site 2) which were about 75 and 180 meters from the pheromone-treated area. The traps with the virgin females (pheromone-treated area: 3 traps at each site; untreated control plot: 3 traps at each site) and the traps for *E. ambiguella* (pheromone-treated-area: 3 traps at site 1; 4 traps at site 2; untreated control plots: 3 traps at both sites) were adjacent to the groups of *S. pilleriana* pheromone-baited traps.

Moreover, squares of ca. 150 m^2 containing 72 vines were established in each pheromone-treated (3 at site 1, 4 at site 2) and control plots (3 at site 1 and). The squares did not receive insecticide treatment and the centered 20 vines of each square were used to estimate egg density in 1998, and larval density in 1999.

The pheromone-treated plots were enlarged to 8,5 ha (site 1) and 11,5 ha (site 2) in 1999. Two additional groups of *S. pilleriana* traps were arranged within the pheromone-treated areas and one additional group in a new control plot in site 2. The number of traps used for checking the moth flight and squares for investigating the number of eggmasses per vine is shown in table 2.

Results

Sparganothis pilleriana

In 1998, treatment with blend 1 reduced moth catch rate in traps baited with synthetic pheromone and virgin females in both sites between 98 and 100% in comparison to the untreated control plots (Table 1). The density of eggmasses was reduced by 99% (site 1) and 84% (site 2) in the pheromone-treated plots (Table 1). Larval infestation rate was reduced by 98% (site 1) and 80% (site 2) after pheromone treatment. During 1999, the catch rate in pheromone traps was decreased by 97% at site 1 and by 99% at site 2. The number of eggmasses per vine was reduced by 91% (site 1) and 83% (site 2). The larval infestation rate will be examined in spring 2000.

Table 1. Effectiveness of a 70:70:60:4:1-blend of E9-12Ac, Z9-12Ac, Z11-14Ac, E9-12OH and Z9-12OH (blend 1) on the different life stages of *S. pilleriana* in 1998/1999

	Treatments			
	Site 1		Site 2	
	Blend 1	Control	Blend 1	Control
Plot size (ha) 1998	5		5	
No. pheromone traps	9	9	12	9
Average catch (± SD) per pheromone trap	0.2 ± 0.4	49.2 ± 16.4	0.9 ± 0.9	90.7 ± 19.1
No. virgin female traps	3	3	3	3
Average catch (± SD) in virgin female trap	0.3 ± 0.6	33.0 ± 21.1	0.3 ± 0.6	49.7 ± 18.5
No. vines examined for eggmasses	60	60	80	60
Average no. eggmasses (± SD) per vine	0.02 ± 0.1	1.6 ± 1.4	0.8 ± 1.1	5.1 ± 4.3
No. vines examined for larvae (1999)	60	60	80	60
Average no. larvae (± SD) per vine	0.1 ± 0.35	4.8 ± 3.14	2.8 ± 2.9	14.1 ± 10.2
Plot size (ha) 1999	8.5		11.5	
No. pheromone traps	15	9	18	12
Average catch per phero-mone trap	1.1	35.6	0.8	151.3
No. vines examined for eggmasses	100	60	120	80
Average no. eggmasses per vine	0.1	1.1	0.5	3.0

Eupoecilia ambiguella

Treatment with blend 1 reduced the capture of moths by 99 - 100% in pheromone traps compared to the untreated control plots in both years at both sites. In 1998, larvae were not found in grapes. This may depend on the high temperature of 40°C which could be measured at some days during summer in the South Palatinate. In 1999, 40% (site 1) and 50% (site 2) fewer larvae were found in the pheromone-treated than in the control plots (Table 2).

Discussion

The results of 1996 showed that a mixture of the main pheromone components of *S. pilleriana* (E9-12Ac) and *E. ambiguella* (Z9-12Ac) resulted in a good catch reduction (83%) of *S. pilleriana* moths in pheromone traps compared with untreated control plots (Schmidt-

Tiedemann *et al*. 1999b). The addition of Z9-12Ac did not decrease the effectiveness of the E9-12Ac (86%) alone.

Different blends of this binary blend were tested in 1997 for their potential as mating disruptants of *S. pilleriana*, but blend 1 (E9-12Ac, Z9-12Ac, Z11-14Ac, E9-12OH, Z9-12OH) produced the best efficacy in reducing the larval infestation rate of the following generation. Three factors may have influenced these results. First, blend 1 was the most complete pheromone blend; second, blend 1 was tested in a 5-ha plot whereas blends 2, 3 and 4 were tested in 1 ha plots and third, the environmental conditions (e.g. predators and parasitoids) were different at both sites.

Excellent results with blend 1 in controlling *S. pilleriana* were obtained in 1998 (trap catch, eggmasses and larvae) and in 1999 (trap catch and eggmasses). The lower effectiveness of the pheromone treatment in site 2 (concerning eggmasses and larval infestation rate) can be explained by the fact that the moth flight was already more advanced in this location when the dispensers were applied in the vineyard.

Table 2. Effectiveness of blend 1 on the different life stages of *E. ambiguella* 1998/1999

	Treatments			
	Site 1		Site 2	
	Blend 1	Control	Blend 1	Control
Plot size (ha) 1998	5		5	
No. pheromone traps	3	3	4	3
Average catch per pheromone trap	2	205	1	439
No. grapes examined for larvae	90	90	120	90
Average no. larvae per grape	0	0	0	0
Plot size (ha) 1999	8.5		11.5	
No. pheromone traps	3	3	3	3
Average catch per pheromone trap	4	607	8	825
No. grapes examined for larvae	125	75	150	100
Average no. larvae per 25 grapes	0.8	1.3	1.5	3.0

Moreover, the pheromone treatment for *S. pilleriana* control appeared to be successful in small plots whereas good control of *E. ambiguella* was not obtained in small plots. The minimum area recommended for treatment with pheromone for this tortricid is 20 ha and we treated only 8,5 and 11,5 ha respectively. This may explain the relatively low efficacy of blend 1 in reducing the larvae of *E. ambiguella* of 40 and 50%. Another point which has to be considered for the interpretation of the *E. ambiguella* data is the time when the dispensers were fixed in the vineyard. *S. pilleriana* was the target insect for this study, and therefore, the experimental design was optimized for this species. By contrast, *E. ambiguella* had begun to fly before pheromone was applied. Better control of *E. ambiguella* would be obtained if the pheromone treatment would be applied earlier. Moreover, E9-12Ac is an attraction inhibitor for *E. ambiguella* (Arn *et al*. 1979) and the blend of both isomers have an repellent effect, as described for *Cydia nigricana* (Bengtsson *et al*. 1994).

This study demonstrates that *S. pilleriana* can be successfully controlled by mating disruption with sex pheromone. There is a good chance that both *S. pilleriana* and *E. ambiguella* can be controlled with a blend containing a blend of E9-12Ac and Z9-12Ac. This method is not registered yet.

Acknowledgements

This study was supported by the Ministry of Economy, Traffic, Agriculture and Viticulture Rheinland-Pfalz (Mainz, Germany). Shin-Etsu Chemical Company Co., Ltd. (Tokyo, Japan) and BASF AG (Ludwigshafen, Germany) provided the dispenser material. Special thanks go to the vinegrowers for their cooperation.

References

Arn, H.; Rauscher, S. & Buser, H. R. 1976: Sex pheromone of *Eupoecilia ambiguella*: cis-9-dodecenylacetate as a major component. Z. Naturforsch. 31 c: 499-503.

Arn, H.; Rauscher, S. & Schmidt, A. 1979: Sex attractant formulations and traps for the grape moth *Eupoecilia ambiguella* Hb. Mitt. der Schweizerischen Entomologischen Gesellschaft 52: 49- 52.

Bengsston, M.; Karg, G.; Kirsch, P. A.; Lövqvist, J.; Sauer, A. & Witzgall, P. 1994: Mating disruption of pea moth *Cydia nigricana* F. (Lepidoptera: Tortricidae) by a repellent blend of sex pheromone and attraction inhibitors. Journal of Chemical Ecology 20(4): 871-887.

Guerin, P. M.; Buser, H. R.; Tóth, M.; Höbaus, E.; Schmid, A. & Arn, H. 1986: Sex pheromone of *Sparganothis pilleriana*: E- and Z-11-Tetradecenylacetates as essential compounds. Entomol. Exp. Appl. 40: 137 - 140.

Roehrich, R. 1977: Compte-rendu de la réunion sur les phéromones sexuelles des insectes, Montfavet 25-27 octobre 1977, INRA Montfavet.

Saglio, P.; Priesner, E., Descoins, C. & Gallois, M. 1977: A synthetic attractant for the grape pyralid Sparganothis pilleriana (Schiffermüller) C. R. Hebd. Seances. Acad. Sci., Ser. D. Sci. Nat. 284, 20, 2007 - 2010.

Schirra, K.-J. & Louis, F. 1995: Auftreten von natürlichen Antagonisten des Springwurmwicklers *Sparganothis pilleriana* in der Pfalz. Deutsches Weinbaujahrbuch 46: 129 -140.

Schmidt-Tiedemann, A.; Louis, F.; Zebitz, C. P.W. & Arn, H. 1999a: Pheromone - Ein Ansatz zur umweltschonenden Bekämpfung des Springwurms (*Sparganothis pilleriana* Schiff.). Deutsches Weinbaujahrbuch 50: 153-158.

Schmidt-Tiedemann, A., Louis, F., Fukumoto, T., Zebitz, C. P. W. & Arn, H. 1999b: Mating disruption tests to control *Sparganothis pilleriana* (Schiff.) (Lepidoptera: Tortricidae). IOBC wprs Bulletin Vol. 22 (*in press*)