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Control of *Sparganothis pilleriana* Schiff. and *Lobesia botrana* Den. & Schiff. in German vineyards using sex pheromone-mediated mating disruption

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Abstract: Investigations were conducted from 1996 to 2000 to determine the feasibility of controlling the tortricid pest *Sparganothis pilleriana* Schiff. using its sex pheromone. Intitially, different pheromone blends were tested in the field and the results have been published in previous papers. In 2000, after treating three generations of the pest with pheromone, the larval infestation was finally evaluated. The pheromone treatment reached a very good efficacy in reducing the larvae. Evaluation of larval density in 2000 after using mating disruption to control three generations of the pest revealed that pheromone could provide economic control. Investigations on the use of the mating disruption technique against another very important tortricid in German viticulture, *Lobesia botrana* Den. & Schiff., showed the control of this pest with pheromones was very effective. Most importantly, mating disruption was effective against an occasional third generation of this pest that cannot be controlled using insecticide. The use of pheromone and insecticide could reduce the density of *L. botrana* to levels where pheromone alone could be used to achieve economic control.

Key words: viticulture, *Sparganothis pilleriana*, *Lobesia botrana*, pheromones, mating disruption, third generation

Introduction

Sparganothis pilleriana Schiff. (Lepidoptera, Tortricidae) is a tortricid native to Germany that causes severe damage in several German and European vine growing regions. Since 1990 in some viticultural regions of Germany, for example in the southern palatinate, the population density of this tortricid has significantly increased and remained at a very high level. The insecticides registered for use in Germany until 1999 were in most cases less successful in reducing the larval infestation below the damage threshold. Based on these problems and the severe economic damage caused

by the pest in 1996 a research project was launched with the objective of developing an environmental friendly method to control *S. pilleriana*.

The grape berry moths *Lobesia botrana* Den. & Schiff. and *Eupoecilia ambiguella* Hbn. are the most important insect pests in German viticulture. The mating disruption technique is registered for both species since 1986 (Eupoecilia) and 1994 (Lobesia). Depending on climatic and other conditions in some viticultural areas both species occur sympatrically whereas in other areas only one species is known to occur. If both tortricids occur together, often one is predominate. In many regions of the palatinate the dominant species is *L. botrana*. There is also a distinct shift: In some areas *Lobesia* populations increase and *Eupoecilia* populations decrease at the same time. A change in dominance has been observed in some areas.

Feldhege (1993) showed that the efficacy of mating disruption of *L. botrana* declined if moth density exceeded approximately 4000 females and males per hectare This is one of the reasons that it is generally recommended not to use pheromone in areas with very high tortricid populations. A high density of *L botrana* is one of the reasons the use of the mating disruption technique did not increase in viticultural practice the last few years. At present in Germany about 20 percent (20.000 ha) of the total viticultural area is treated with the mating disruption technique to control *L. botrana* and *E. ambiguella*.

Mating disruption was observed beginning in 1992 for control of *L. botrana*. In a second project initiated in 1999 the main goal was to determine if it would be possible to combine the use of mating disruption and insecticide to reduce *L. botrana* density to a level where pheromone alone could be used to achieve economic control. In the past two to three years in several German vine growing regions a third generation of *L. botrana* developed. Insecticides cannot be used against this generation due to the short time before harvest. Therefore, an important question to answer was if pheromones could have an impact on the development of the third generation of *L. botrana.*

Materials and methods

Sparganothis pilleriana

Over a period of four years (three pest generations) mating disruption tests on different sizes plots (1 – 5 ha) were conducted in the South Palatinate. A mixture of different components of the sex pheromone of *S. pilleriana* (blend 1: *E*/*Z*9-12:Ac; *Z*11-14:Ac; *E*/*Z*9-12:OH) was used. The experimental design used during 1996 to 1999 have been described in previous IOBC Bulletins (IOBC Dachau, Hohenheim, Schmidt-Tiedemann et al. 1999, in press). In spring 2000 the number of larvae per vine was examined within the same small check-plots not treated with insecticides in which the number of eggmasses was evaluated in 1999.

Lobesia botrana

In one 60 ha test area (site 1) having intermediate to low population pressure RAK 1+2 (BASF, 500 dispensers per ha) was used to control *L. botrana* (Louis and Schirra 2001, in press). Evaluations were conducted in this site beginning in 1992 to examine the long term effect of the mating disruption over a period of years.

A second test area (site 2) was located 200 m from site 1. This site had a very high population density of *L. botrana* and was used until 1998 as the untreated control for calculating the degree of effectiveness of the mating disruption in site 1. In 1999 in site 2 a two-year project was begun to evaluate the combined use of mating disruption and insecticide for controlling *L botrana*. The main goal of this project was to examine if by using insecticides together with pheromones the individual density of the tortricids could be reduced to a level low enough for exclusive use of mating disruption technique in future seasons. To get to know something about the efficacy of the pheromone treatment control plots not treated with insecticides were established within site 2.

In 2000 another project to assess the effect of pheromones on the third generation of *L. botrana* was begun The flight activity of the third moth generation in untreated control plots was compared with the flight activity in site 2 and in a 10 ha-area within site 2, where in August 2000 new RAK 1+2 dispensers were applied. For montoring the flight activity pheromone traps were used.

Results and discussion

Sparganothis pilleriana

In 2000 the pheromone treatment reduced larval density to 86 % at site 1 and 79 % at site 2 (Table. 1). A comparison with the results of 1998 and 1999 using blend 1 (80 % to 98 %) showed that the effectiveness of using sex pheromone is in most cases better than the effectiveness of insecticides. In addition to its effectiveness, the use of mating disruption has further advantages. The long period of emergence of the larvae out of their overwintering sites in spring makes it extremely difficult to determine the right date for the application of insecticides. Moreover the larvae live in leaf shelters that give them protection against insecticides. The investigations also showed that the pheromone treatment is successful in small plots (5 - 11,5 ha) in contrast to the experiences with *E. ambiguella* and *L. botrana* where a plot size of at least 20 ha is required for successful use of mating disruption.

In this project an environmental friendly way was developed to control *S. pilleriana* by use of sex pheromone in mating disruption technique (sex pheromone-mediated mating disruption) with very high effectiveness. This method is

not registered yet. One reason for this might be due to the relatively small areas in Europe infested by *S. pilleriana*.

	Treatments 1999/2000			
	Site 1		Site 2	
	Blend 1	Control	Blend 1	Control
Plot size [ha]	8,5		11,5	
No. pheromone traps	15	9	18	12
Average catch (± SD) per pheromone trap	1,1±1,22	35,6±13,07	0,8±2,15	151,3±170,0
No. of vines examined for eggmasses	100	60	120	80
Average no. of eggmasses per vine	0,1±0,33	1,1±1,22	0,5±0,75	3,0±4,20
No. of vines examined for larvae	100	60	120	80
Average no. of larvae per vine	1,0±1,5	7,15±5,86	2,9±2,97	11,3±8,68

SD = Standart Deviation

Table 1. Effectiveness of blend 1 (*E*/*Z*9-12:Ac; *Z*11-14:Ac; *E*/*Z*9-12:OH) in mating disruption of *S. pilleriana* in grape vine

Lobesia botrana

Between 1992 and 1998 the mating disruption technique used in site 1 was very successful. In most cases the degree of effectiveness was higher than 90 % for the first larval generation (Figure 1) and more than 97 % for the second larval generation (Figure 2). In the untreated control plots for the first generation the average rates of infestation ranged between 50 and 100 larvae per 100 inflorescences. For the second generation approximately 200 to more than 600 larvae per 100 clusters could be found in the vegetation periods investigated.

In 1999 in site 2 within the first year of the combined treatment with pheromones and insecticides the effect of disorientation reached 94,3 % for the first generation of *L. botrana* and 92,1 % for the second moth generation. Compared to the results obtained in site 1 (99,3 % for both generations), these low efficacy rates could be expected in the first year. In 2000 the disorientation rates in site 2 were significantly higher reaching 98,4 % in the first moth generation (Figure 3) and 99,5 % in the second generation (Figure 4). The results obtained for the second moth generation were almost as good as those obtained in site 1 (99,6 percent).

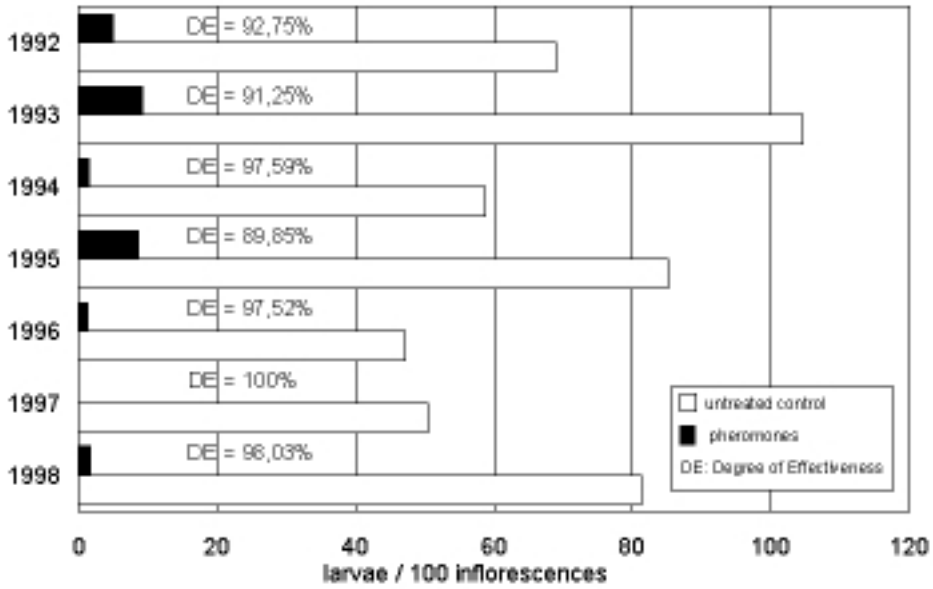

Figure 1. Effect of pheromone treatment (RAK 1+2) on the first generation of *Lobesia botrana*, 1992 - 1998, Neustadt - Haardt

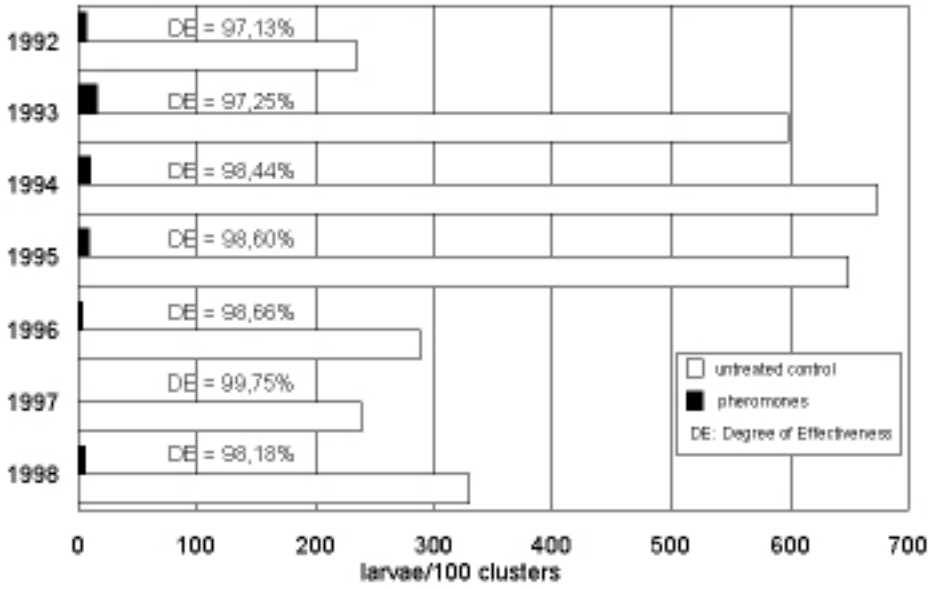

Figure 2. Effect of pheromone treatment (RAK 1+2) on the second generation of *Lobesia botrana*, 1992 - 1998, Neustadt - Haardt

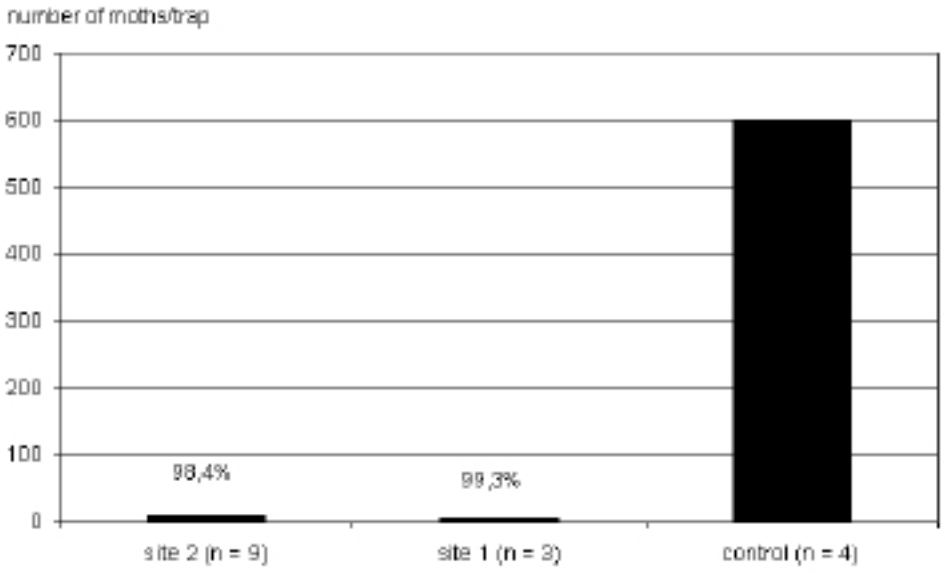

Figure 3. Effect of pheromone treatment on the capture of *Lobesia botrana* – moths in pheromone traps, first generation 2000, Neustadt – Haardt

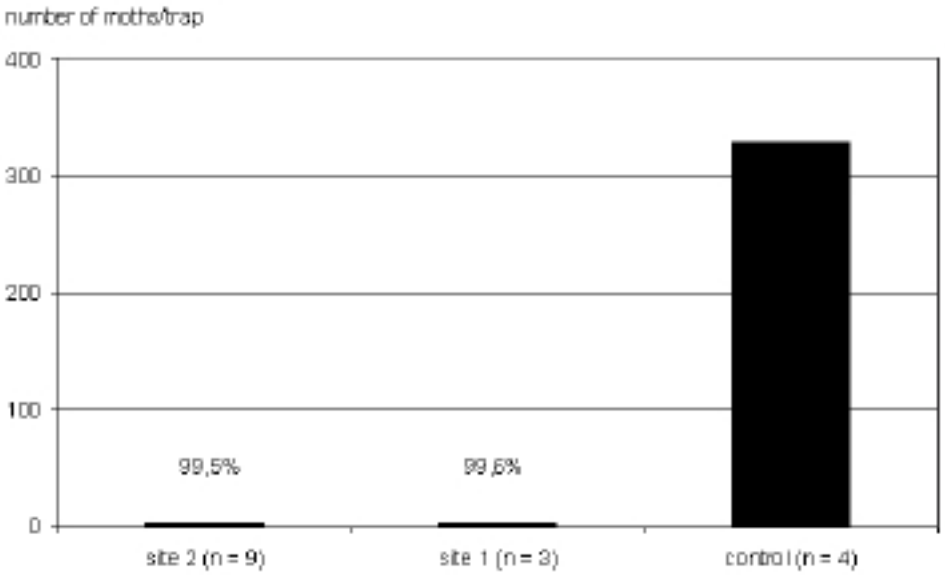

Figure 4. Effect of pheromone treatment on the capture of *Lobesia botrana* – moths in pheromone traps, second generation 2000, Neustadt – Haardt

The infestation rates at site 2 before the beginning of the combined treatment, 1992 - 1998, were evaluated within untreated control plots (control plots for pheromone site 1), where the infestation was extremely. The results obtained using the combined treatment in 1999 and 2000 were evaluated in small control plots without inseciticide

application to determine the exclusive effect of the mating disruption technique. In 2000, the infestation rates within these pheromone plots were significantly lower than in the years 1992 – 1998 (Figures 5 and 6).

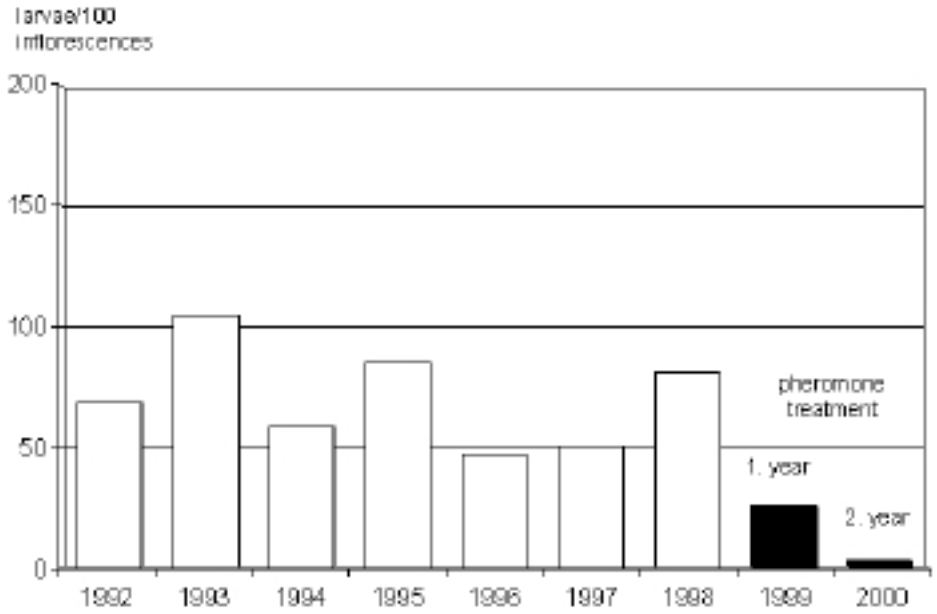

Figure 5. Infestation rates of *Lobesia botrana* – larvae, first generation in site 2 (1992 – 2000), Neustadt - Haardt

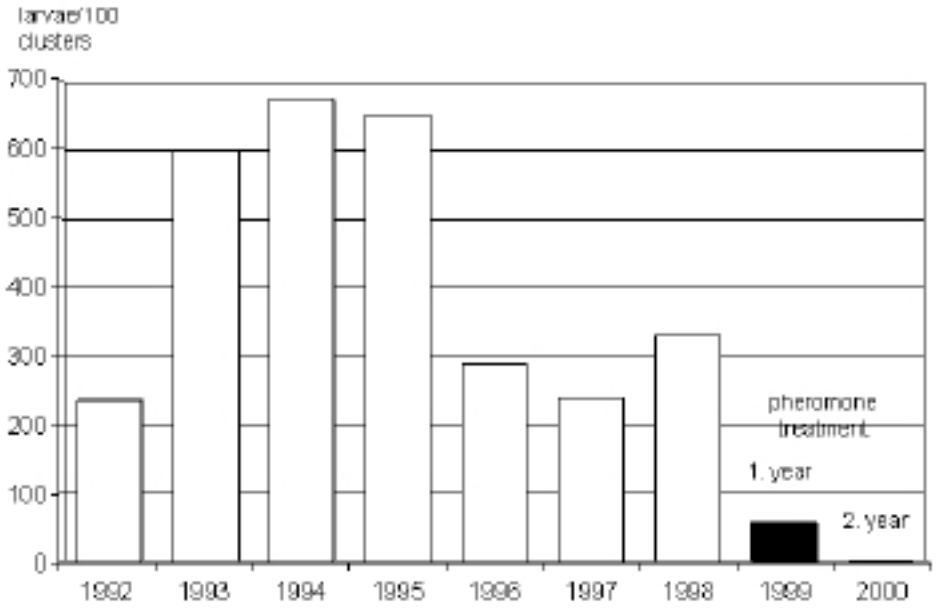

Figure 6. Infestation rates of *Lobesia botrana* – larvae, second generation in site 2 (1992 – 2000), Neustadt - Haardt

These results provide evidence that the combined use of insecticide and mating disruption can be used to reduce population density of *L. botrana* to a level where mating disruption alone can be used to control this pest.

The results also demonstrate that pheromone applied before the onset of flight of the first generation in April remained highly effective until the end of the third moth flight in October. In vineyards in which new pheromone dispensers were applied shortly before the beginning of the third flight in August a disorientation rate of 100 % was achieved (Figure 7).

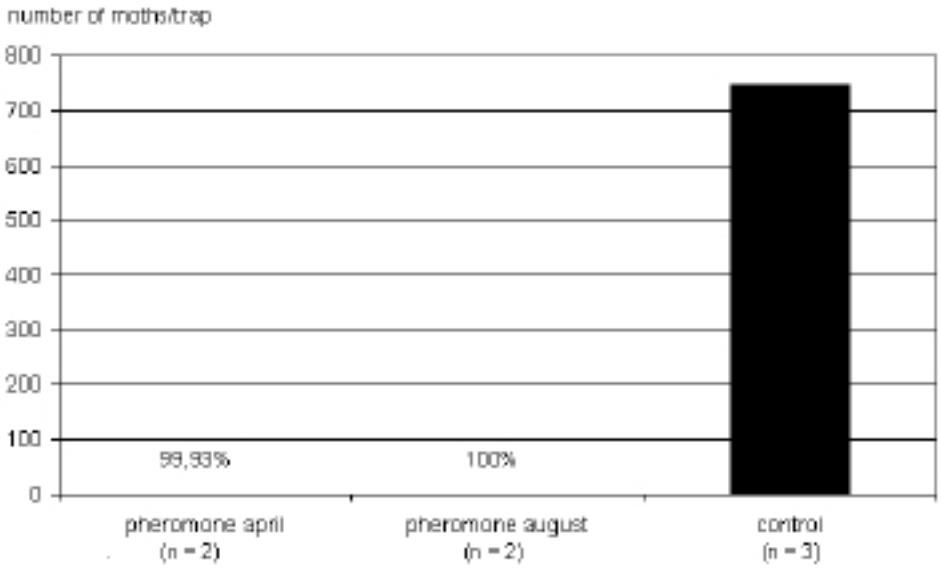

Figure 7. Effect of pheromone treatment on the capture of *Lobesia botrana* males in pheromone traps, third generation 2000, Neustadt - Haardt

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