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Performance of five sex attractant formulations for the grape moth, Eupoecilia ambiguella Hb., in European vineyards

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Five formulations of *(Z)*-9-dodecenyl acetate with various additives were tested as sex attractants for *E. ambiguella* Hb., in European vineyards. Formulations on polyethylene with dodecyl acetate as a synergist attracted the highest numbers of moths but were only effective during the first flight. Addition of 11-dodecen-1-ol on a rubber septum gave higher catches than *(Z)*-9-dodecenyl acetate alone and was effective during both flights. No major differences in the relative performance of the formulations in the different wine growing areas were detected.

The sex pheromone of the European grape moth, *E. ambiguella* Hb., was found to consist, at least in part, of *(Z)*-9-dodecenyl acetate (ARN *et al.,* 1976; SAGLIO *et al.,* 1976). It is interesting that the same chemical has been known for some time as the pheromone of the American grape berry moth, *Paralobesia viteana* (CLEMENS) (ROELOFS *et al.,* 1971). Traps baited with *(Z)*-9-dodecenyl acetate catch *E. ambiguella* males but are not as attractive as the live females. This indicates that the natural pheromone may contain other, yet unidentified components. Several synthetic chemicals, notably dodecan-1-ol, 11-dodecen-1-ol (SAGLIO *et al.,* 1976) and dodecyl acetate (ARN *et al.,* 1979) have been found to enhance the attractiveness when added to *(Z)*-9-dodecenyl acetate. The present study was conducted to determine which of these «artificial» sex attractant mixtures is the most suitable for monitoring grape moth flights in the various wine-growing regions of Europe.

The attractant formulations used in this test were as follows:

A: Rubber septum with 1 mg *(Z)*-9-dodecenyl acetate (0.1% *E* isomer)
B: Rubber septum with 1 mg *(Z)*-9-dodecenyl acetate (0.1% *E*) + 0.1 mg dodecan-1-ol
C: Rubber septum with 1 mg *(Z)*-9-dodecenyl acetate (0.1% *E*) + 0.1 mg 11-dodecen-1-ol
D: Polyethylene capsule with 1 mg *(Z)*-9-dodecenyl acetate (2% *E*) + 5 mg dodecyl acetate
E: Polyethylene capsule with 1 mg *(Z)*-9-dodecenyl acetate (0.1% *E*) + 5 mg dodecyl acetate.

The rubber septa were purchased as «bouchons pour tube à allergie» from Ets. Leune, 28bis rue du Cardinal Lemoine, F-75005 Paris, and similar to those used by Zoecon Corporation. The polyethylene capsules consisted of a 10 mm o. d. tube closure no. 2.1449 from Semadeni AG, CH-3072 Ostermundigen, capped with an inserted 8.5 mm closure no. 2.1446.

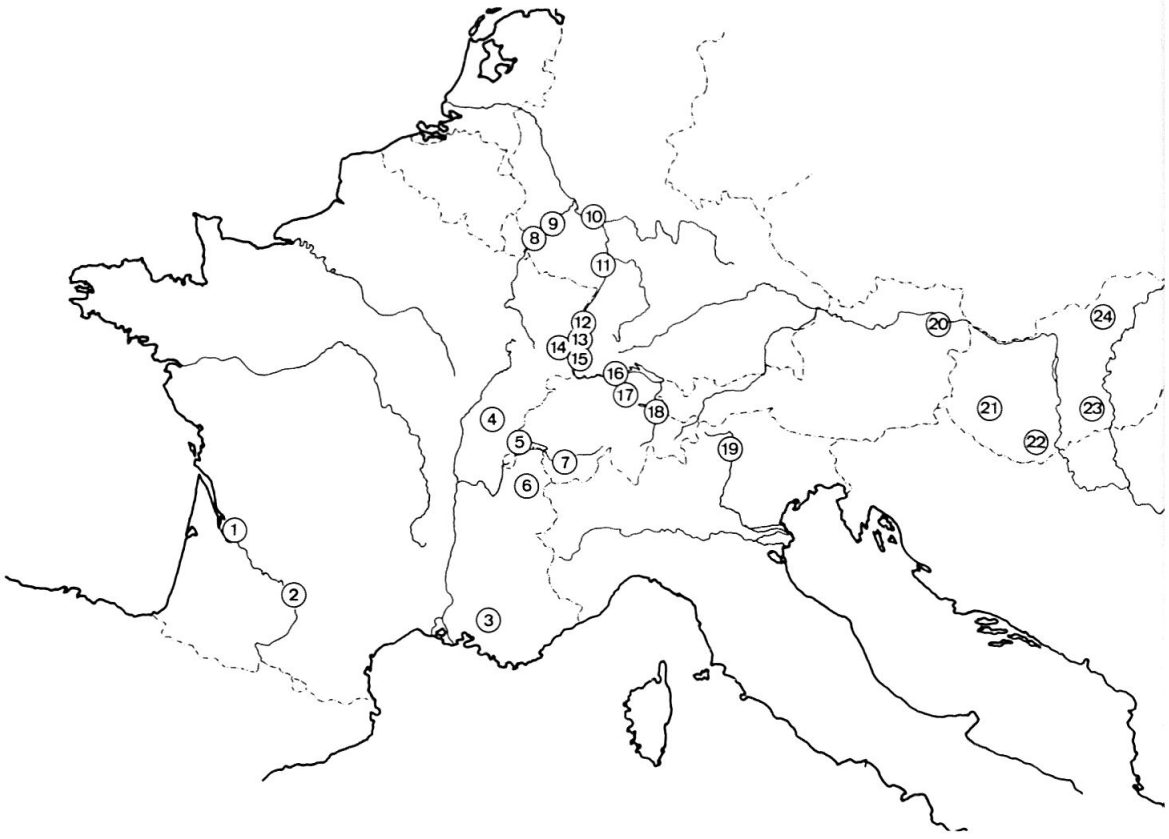

Fig. 1: Locations of attractant test. The numbers refer to table 1.

Traps baited with each formulation were placed in vineyards in various locations in 1977, as shown in fig. 1 and table 1. Distances between traps were 20 to 40 m. Participants of the test chose their own traps. The sequence of traps was changed randomly for every replicate. No changes in trap placement or replacements of attractant dispensers were made during the season. Catches of *E. ambiguella* were recorded through both flights, *i.e.* from mid-April to mid-August. A third flight in September was reported from the South of France (Manosque), Austria (Gumpoldskirchen) and Hungary (Eger and Pécs).

The results are given in table 1. Substantial catches were obtained with all formulations tested; between formulations the total catches differed within a factor of two in the first flight and 3 in the second. For statistical analysis data were pooled using in each chosen area only the three replicates which had accumulated the highest catches. Thus, 13 sets of replicates from locations 3, 5, 10, 12, 13, 14 + 15, 16, 17, 18, 19 (2 sets), 23 + 24 were analysed. Totals of each trap were transformed to log (x + 1) and submitted to analysis of variance.

During the first flight the highest catches were obtained with formulations D and E containing dodecyl acetate as a synergist. In a concurrent experiment in Switzerland (ARN *et al.*, 1978), formulation E outcaught traps baited with laboratory-reared females by a factor of 3. Formulation C containing 11-dodecen-1-ol was significantly less attractive than formulation E but better than the control (A) containing no additive. Dodecan-1-ol (B) had no apparent effect on catches. In the second flight formulation C made the highest catches while the performance of D and E dropped off. As was shown in other tests this was due to the more rapid depletion of the polyethylene capsules. Thus, polyethylene capsules should be

Table 1: *Eupoecilia ambiguella* catches with five sex attractant formulations in various locations.

Map No.	Location	Type of Trap		Total Catch First Flight A	B	C	D	E	Total Catch Second Flight A	B	C	D	E
1	Tresses	INRA[1]	2	1	1	1	1	1	8	8	3o	o	o
2	Fronton	INRA	2	1	2	o	o	1	2	1	9	2	o
3	Manosque	INRA	4	259	453	4oo	643	629	248	335	343	248	96
4	Le Vernois	INRA	2	136	43	85	74	149	571	229	467	247	3o3
5	Perroy	OILB[2]	3	161	212	239	428	234	221	295	347	32	3o
6	Chambéry	INRA	4				(35	71)[5]				(47	115)
7	Charrat	OILB	3	87	67	75	39	43					
8	Trittenheim	Pherocon 1C[3]	2				(46	122)				(15	27)
9	Kröv	Pherocon 1C	2				(266	275)				(5	21)
1o	Geisenheim	Pherocon 1C	2	15	29	26	23	14	1o4	144	2o6	o	6
	Johannisberg	Pherocon 1C	2	4o	29	5o	13	43	262	1o6	3o5	47	61
	Eltville	Pherocon 1C	1	4	6	2	4	15	34	23	58	o	8
11	Deidesheim	Pherocon 1C	2	16	5	1o	11	28	61	6o	43	56	115
	Meckenheim	Pherocon 1C	2	1o	2	5	4	12	43	22	23	19	27
12	Durbach	Flower Pot[4]	2	8	1o	14	33	87	132	158	199	98	133
13	Achkarren	Flower Pot	2	5	3	2	1o	22	14	65	5o	8	55
	Broggingen	Flower Pot	2	1o	8	31	43	65	59	75	232	8o	51
14	Riquewihr	Pherocon 1C	2	1o9	1o9	91	8o	135	199	154	3o8	o	o
15	Müllheim	Flower Pot	2	29	75	175	191	172	4o4	597	73o	178	3o9
16	Teufen	Pherocon 1C	3	44	44	139	82	141	118	142	455	19	34
17	Stäfa	OILB	3	24	16	21	38	35	176	1o6	27o	16	21
18	Malans	OILB	3	82	83	116	182	380	561	485	723	2o1	498
19	Kaltern	Pherocon 1C	3	18	18	23	48	61	7oo	584	1424	44	28
	Tramin	Pherocon 1C	3	3o	17	21	25	46	754	39o	715	7o	31o
	Girlan	OILB	3	o	3	4	28	47	45	41	42	1	6
2o	Gumpoldskirchen	Pherocon 1C	3	8o	37	87	49	45	134	78	2o4	77	153
21	Badacsony	similar to INRA	2	5	5	o	1	2	3	1	2	2	o
22	Pecs	similar to INRA	2	4	o	o	1	o	74	55	46	o	o
23	Kecskemet	similar to INRA	2	2	2	1	1	1	69	38	52	8	29
24	Eger	Sectar[3]	2	6	5	17	35	37	51	31	98	7	17
	Total		78	1186	1284	1635	2o87	2445	5o47	4223	7381	146o	229o
	Duncan's Test with pooled data[6]			a	a	b	bc	c	d	d	e	f	g

[1]Stöckel, 1976, [2]Baggiolini & Granges, 1972, [3]Zoecon Corporation, Palo Alto, California, [4]Neuffer, 1974, [5]Data of incomplete sets not included in the total, [6]Means followed by the same letter are not different at the 95% probability level.

replaced for the second flight. A content of 2% *E* isomer in formulation D did not affect catches significantly. It may nevertheless be advisable to use purified materials since isomeric purity of commercial products is variable and the *E* isomer is inhibitory at higher amounts and not necessary for attraction.

Polyethylene was a more selective attractant carrier than rubber; at Geisenheim (location 10), Riquewihr (location 14), Stäfa (17) and Gumpoldskirchen (20), catches of *Lobesia botrana* SCHIFF., were made at an average of 19.7 per trap with formulations A through C and of 2.2 with D and E. Formulations A, B and C also caught significant numbers of *Spilonota ocellana* F. at Pécs (22) and Eger (24).

Statistical analysis revealed no significant difference in the relative performance of the five formulations in different regions. This does not answer the question of biotypes not responding to the known attractant, as were found to exist in *L. botrana* (ROEHRICH, 1976). This question along with the correlation of trap catches with population density will deserve further attention. The present study indicates that the synergized mixtures known today may be useful for monitoring the flight of *E. ambiguella* until the entire pheromone bouquet of this species is chemically defined.

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