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Strategy for the integrated control of pear pests by the use of an insect growth regulator as a key element

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A new insect growth regulator, CGA 45 128, was used for three consecutive years against the last instar larvae of *Adoxophyes orana* F.v.R. in spring and caused a fruit damage reduction to 9, 0.8 and 1% respectively. Typical deformations for this type of compound could be observed on all sampled larvae. CGA 45 128 was fully selective to the anthocorids which helped to keep psyllid populations at an acceptable level.

INTRODUCTION

The pear production in Europe is threatened by two pests mainly: the fruit tortrix moth *Adoxophyes orana* F.v.R. and several psyllid species, in particular *Psylla piri* L. While the tortricid can be well controlled, psyllids caused serious problems in several regions over the past decade (IOBC, 1983).

One of the reasons for these problems was insufficient coverage of big pear trees, resulting in sublethal dosage rates, which initiate a quick build-up of resistance with psyllids. In addition, certain insecticides are deleterious to anthocorids which are the most important group of psyllid predators.

New strategies in pear pest control aim at the introduction of more selective insecticides and a shift of the treatments against *A. orana* from the summer generation to the overwintering larvae. A growth regulator type of compound with activity against the last instars would suit such a system very well because the damage to the foliage in springtime by this leafroller is acceptable. Anthocorids are not vulnerable to this type of substance because they are only present in the adult stage at this time of the year. An insect growth regulator (IGR) with the code number CGA 45 128 displays the required properties. To test its suitability for the suggested system was the purpose of the present study.

MATERIALS AND METHODS

The experiments were carried out in 1985, 1986, and 1987 in pear orchards in the Swiss Rhone valley. The locations and relevant treatments are listed in Table 1.

A. orana was treated with CGA 45 128. The systematic chemical name is N-ethyl O[2-(4-phenoxyphenoxy)-ethyl] carbamate.

It has morphogenetic action on the last larval instars of this leafroller species, resulting in deformed larvae, pupae and adults. It was compared to check orchards where only psyllids were controlled. All pesticides were applied with a turbo sprayer at 1400 l water/ha against overwintering pests and at 400 l/ha during the growing season.

Table 1. Treatment list in pear insect control trial

	Trial site	Pest	Active ingredient (a.i.) and formulation	Rates g a.i./100 l	Dates of treatment
1985	Riddes A	PP[a]	IGR[c] EC 100 + mineral oil (50 %)	50 + 300	April 3 / 13
	0.5 ha	AO[b]	CGA 45 128 EC 250	5	May 16 / 27
		PP	Amitraz EC 200	50	June 27
	Riddes B	PP	DNOC SC 500	375	Febr. 26
	0.3 ha	AO	No treatment		
1986	Riddes A	PP	DNOC SC 500	375	March 6
	0.5 ha	AO	CGA 45 128 EC 100	1.25 & 2.5	May 12 / 23
	Saxon B	PP	Mineral oil (99 %)	200	March
	0.5 ha	AO	No treatment (?)		
1987	Riddes A	PP	DNOC SC 500 & mineral oil (50 %)	375 + 350	March 23 & April 2/24
	0.5 ha	AO	CGA 45 128 EC 100	2.5	May 8/20
	Saxon A	PP	Mineral oil	350	April 7
	0.4 ha	AO	CGA 45 128 EC 100	2.5	May 9/25
		PP	Amitraz EC 200	50	July 7
	Saxon B	PP	Mineral oil (99 %) & soap	200	March & several times
	0.5 ha	AO	No treatment		

a) PP-*Psylla piri* b) AO-*Adoxophyes orana*

c) Insect growth regulator 5-(4-phenoxyphenoxy-l-pentin)

The damage caused by all pests was rated at harvest by counting all fruits from 4 trees per treatment.

The development of psyllids and anthocorids during the growing season was followed up by visual inspections on 100–400 relevant organs (inflorescences, terminals) but the figures indicated here apply to 100 organs.

RESULTS AND DISCUSSION

The fruit tortrix moth was well kept under control in all three years (Table 2). Larvae treated with CGA 45 128 sometimes tend to stay longer on the foliage which may result in some nibbling damage on the newly formed fruits. When 60 *A. orana* last instar larvae were caged in 1986 on treated branches, all of them demonstrated the deformations typical for growth regulators. The total leafroller

Table 2. Damage rating (%) of *Adoxophyes orana* and *Psylla piri* on pear fruits at harvest

Trial sites		Adoxophyes		Psylla		Other pests [a]
		spring	summer	slight	severe	
1985	Riddes A (IGR)	7	2	22	0	2
	Riddes B (Check)	No rating at harvest				
1986	Riddes A (IGR)	0.4	0.4	10	0.2	2
	Saxon (Check)	2	2	10	2	5
1987	Riddes A (IGR)	0.2	0.8	6	0	4
	Saxon A (IGR)	0	0.2	15	0.4	2
	Saxon B (Check)	1	1	14	1	6

a) Noctuid Larvae, mirids, San José scale, sawflies

damage was commercially acceptable in the first year since all these fruits went for distillation. The leafroller population had decreased in the following two years in the same orchard to a negligible level which is a general experience with this type of compound (CHARMILLOT & BLASER, 1985).

A strong reduction of *Psylla piri* could be achieved by the proper timing of another growth regulator or DNOC against overwintering adults (Table 3). Resurging populations in 1985 and 1987 were kept under control during the growing season by applying amitraz against the eggs. The sooty aspect of mould growing on honey dew excretions of psyllid larvae was only slight (Table 2).

Complementary selective control measures were pirimicarb against aphids, diflubenzuron against noctuid larvae, and a mixture of penconazol and captan for the control of apple scab and mildew.

Anthocoris nemoralis F. and *A. nemorum* L. were present all through the growing season except in general from May to mid-June (Table 3). This is a critical period and most often the moment when corrective treatments against psyllids become necessary. A selective product such as CGA 45 128 allows the full survival of anthocorids at the beginning of the growing season keeping the psyllid population at a low level.

The application of a single compound against both important pear insect pests would be the most convenient control method for the fruit grower. This

Table 3. Seasonal development of *Psylla piri* and anthocorid larvae and adults by visual inspection in pear orchards (% occupation)

	Trial site		March	May	June			July				Aug.		
			2	28	10	14	28	3	10	18/19	25	2	8	17
1985	Riddes A (IGR)	PP[a]	49	37	43	98	82	35	55	11	16	70	6	11
		AN[b]	2	0	0	1	0	5	6	10	14	8	32	27
	Riddes B (Check)	PP	1	6	68	12	42	44	14	100	98	-	10	10
		AN[b]	0	0	0	0	0	0	0	4	48	10	-	0
			May		June			July						Aug.
			22	28	10/12	16	24/25	2/3	6	8/10	14/16	22/24	29/30	5/12
1986	Riddes A (IGR)	PP	1	3	7	5	8	18	5	10	42	60	32	4
		AN[b]	0	0	0.3	0.3	1	1	5	1	2	8	17	5
	Saxon B (Check)	PP	4	25	21	-	32	17	-	20	17	21	22	14
		AN[c]	0.3	0	2	-	10	10	-	4	3	18	10	5
			May		June			July				Aug.		
			20	26	2	11/12	17	23/24	6	15	23	29	5	19
1987	Rides A (IGR)	PP	0	4	4	22	11	27	35	52	66	50	42	21
		AN[b]	0	0	0	1	2	2	3	3	16	3	13	10
	Saxon A (IGR)	PP	14	7	18	14	16	39	90	99	33	22	54	10
		AN[b]	0	0	1	3	0	5	4	6	10	7	14	6
	Saxon B (Check)	PP	83	88	74	75	98	44	100	84	57	25	40	17
		AN[c]	0	0	1	19	21	7	11	9	11	7	12	7

a) PP-*Psylla piri* b) AN-*Anthocoris nemoralis* c) *Anthocoris nemorum*

worked very well in the past with organophosphates until the appearance of serious resistance problems with psyllids in northern Italy, which were caused by many successive generations and sublethal rates of insecticides in the crown canopy of traditionally high grown pear trees (PICO & PICO, 1978). The problem was aggravated by the use of pyrethroids. Psyllid control became difficult in parts of Switzerland (STAEUBLI, 1983), France (BASSINO, 1983), and the Netherlands (BLOM *et al.*, 1985). Pyrethroids are detrimental to anthocorids as most important natural enemies of psyllids (VEZ, 1978; HAGLEY & SIMPSON, 1983). Growth regulators such as CGA 45 128 or phenoxycarb allow the control of *A. orana* already in early springtime, but are harmless to anthocorid adults which are the only stage of this predator present at this time of the year (MONNET, 1986, REEDE *et al.*, 1985). This is one of the rare cases of a really efficient insect pest antagonist. Its mid-season absence for several weeks from pear orchards can cause a critical resurgence of psyllid populations. Fortunately, there is amitraz available as a selective compound for corrective treatments as long as there is no resistance to this product. It would be interesting to know where anthocorids stay during the months of May and June and whether it would be possible to manipulate the envi-

ronment in such a way (e.g. by intercrop planting of attractive host plants as suggested by FYE, 1983) to make pear orchards attractive to anthocorids also during this period.

CONCLUSIONS

In these experiments the insect growth regulator CGA 45 128 proved its good activity against leafrollers and its full selectivity on anthocorids. Therefore, by the use of such a type of compound these predators could display their full potential as biological control agents of psyllids.

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RÉSUMÉ

Stratégie de la lutte intégrée contre des ravageurs sur poiriers par l'emploi d'un régulateur de croissance comme élément principal – Un nouveau régulateur de croissance, CGA 45 128, a été utilisé en deux traitements contre le dernier stade larvaire d'*Adoxophyes orana* en printemps. Les fruits endommagés ont été ramenés au cours des trois années à 9, 0.8 et 1% respectivement. Des malformations typiques ont été constatées sur toutes chenilles retrouvées sur les poiriers traités. Aucune action négative du CGA 45 128 n'a été observé sur les anthocorides qui ont largement contribué à maintenir les psylles à un niveau tolérable.

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