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Particle Film Technology: approach for a biorational control of *Cacopsylla pyri* (Rhynchota Psyllidae) in Northern Italy

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Abstract

Two trials were carried out to investigate the efficacy of a kaolin-based product (Surround WP) a white non-abrasive, fine-grained alluminum-silicate mineral in controlling pear psylla *Cacopsylla pyri* (L.) oviposition. The trial was carried out in Italy's Emilia-Romagna Region on cv. Abbè Fétel during late winter in 2001-2002 year; the reference product was mineral oil. The timing of product application was before or at the onset of egg laying during overwintering. The results show a very good efficacy of kaolin in comparison to the mineral oil and untreated control. No eggs were found on the treated plants and no phytotoxic effects were observed. No nymphs were observed inside the flowers in the kaolin-treated plots.

Key words: Particle Film Technology, *Cacopsylla pyri*, kaolin, pear, biorational, IPM.

Introduction

Of the Psillids associated with pear, *Cacopsylla pyri* (L.) represents the most economically important pest in Italy's orchards; four other species, *Cacopsylla bidens* (Sulč), *Cacopsylla notata* (Flor), *Cacopsylla pyricola* (Förster) and *Cacopsylla pyrisuga* (Förster), are of secondary importance (Conci *et al*., 1993; Pollini, 2002). In northern Italy's pear districts, *C. pyri* completes 4-5 generations per year. The advanced nymphs are exposed to short photoperiod in autumn and give rise to adults of the winterform morph (*tipica*), which undergoes a reproductive diapause (Bonnemaison and Missonnier, 1956; Nguyen, 1975; Rieux and D'Arcier, 1990; Stratopoulou and Kapatos 1995); overwintering females lay eggs the following February-March (Faudrin, 1984; Trapman and Blommers, 1992). After egg hatching, the pear psilla go through five nymph stages and in April become adults (summerform). The winterform morph (*simulans*) of *C. pyricola* has a notably broad range and a large number of adults leave the orchards in autumn (Horton *et al*., 1994) and return to them in late winter or early spring when temperatures rise (Horton *et al*., 1992); additional studies indicate that *C. pyri* has a less of a tendency than *C. pyricola* to hibernate outside the pear orchard (Trapman and Blommers, 1992). Yet many other aspects of winterform biology are poorly understood, despite the pest status of the insect. This lack of information is of concern because of the emphasis many control programmes place on treating the overwintering forms, with initial spraying to take place after most adults have re-entered the orchard but before egg laying has occurred. While piretroid insecticides are the commonly recommended products in that period, they are highly toxic to beneficials, e.g. *Anthocoris nemoralis* F. (Rhynchota Anthocoridae). Thus, although there are contrasting views in this connection, chemical control of the overwintering generation is not recommended in IPM protocols of Italy's Emilia-Romagna Region, one of Europe's leading pear districts (Barbieri *et al*., 1986; Nicoli and Marzocchi, 1992; Pollini *et al*., 1992; Civolani, 2000; Civolani and Pasqualini, 2003).

In the Emilia-Romagna, the nymphs of the late-spring, second generation represent the target for primary control strategies (Pollini *et al*., 1992; Pasqualini *et al.,* 1997). *C. pyri* damages pears in several ways: the honeydew excreted by nymphs falls onto leaves and fruits and may kill leaf tissue and russet the fruit. Honeydew serves as a growth medium for black sooty mould fungi, whose presence on fruit reduces market value. The cvs. Bartlett and Doyenne du Comice are the varieties most susceptible to *C. pyri* in Emilia-Romagna (Pollini, 2002), together the nurseries too. In addition, loss of crop and tree vigour, and sometimes loss of trees, can occur from Pear Decline, a disease caused by a mycoplasma-like organism (MLO). *C. pyri* is in fact considered the main vector responsible for disease infection and its spread (Carraro *et al*., 1998; Davies *et al*., 1998; Guerrini *et al*., 2000).

There is evidence in our district that in the absence of selective insecticides, used mainly to control codling moth *Cydia pomonella* L. (Lepidoptera Tortricidae), pear psylla reaches damaging density (*resurgence*) because of the toxicity toward the main economic predator *A. nemoralis* (Civolani and Pasqualini, 1999; Pasqualini *et al*., 1999; Civolani *et al*., 2001). Although a non-disruptive tactic for controlling codling moth would improve natural control of pear psylla, there is need of a similar alternative for management of this latter pest. Biological control alone is not effective enough to prevent damage, especially that caused by second-generation pear psylla nymphs feeding on shoots and leaves. Reported alternatives to chemical control include the potential of tree washes in management of pear psylla (Briolini *et al*., 1989; Faccioli, 1990; Pasqualini *et al*., 1997) and microbiological control (Puterka, 1999), which can also be used in a pear IPM program.

Particle film technology (PFT) has emerged as a new method for controlling arthropod pests and diseases of agricultural crops PFT is based on kaolin (Surround WP), a white non-abrasive, fine-grained allumino-silicate mineral that is purified and sized so that it easily disperses in water and creates a mineral barrier on plants that prevents oviposition and insect feeding (Glenn *et al*., 1999; Puterka *et al*., 2000). These researchers suggest it has a mechanism of arthropod and disease suppression in plants: for example, Psyllids can be repelled from pear or infestations suppressed on a plant coated with a particle-film barrier by making the plant visually or tactually unrecognisable as a host. Insect movement, feeding, and other physical activities can be severely impaired by the attachment of particles to the arthropods body as they crawl upon the film, while oviposition is reduced by modifications of the cuticle structure of the bark. The possibility of a convenient and rational control of pear trees with PFT in late winter were thus evaluated during 2001-2002 in a conventional pear orchard of the Emilia-Romagna Region. The aim of the present investigation was to suppress the egg laying of *C. pyri*'s overwintering generation and to assess early season pear psylla population density.

Materials and methods

The trials were carried out in a 10-year-old cv. Abbè Fetél commercial pear orchard during 2001-2002 years in Ferrara Province. The treatments were (1) untreated control, (2) kaolin (Surround WP) and (3) mineral oil; treatment schedules are shown in table 1. The treatments were applied prior to first egg laying, i.e. before temperatures rose above 10°C for two consecutive days, and repeated only for Surround WP because of havy rain (figures 1a, b). The mineral oil was used because it has anti-ovipositional action for several pests, although it is not commonly used to control pear psylla adults.

The treatments were delivered using a backpack pump (KWH model) calibrated to deliver 15hl/ha (standard spray volume). The trial design was a randomised block with four replications (plot consisted of four trees).

C. pyri density was estimated by counting the eggs on 100 bud samples per replicate and the subsequent nymph stages (first generation) on 100 flowers per plot during bloom. The sampling results were compared using ANOVA and the average data were separated using the LSD test. The data were transformed [*log (x + 1)*] before analysis. Observations to evaluate any phytotoxic effects on leaves, flowers, and fruits and visual observation of fruit set were performed.

Results

The resulting data of the two field trials (2001 and 2002) showed a significant difference between treatments for psylla egg average (P = 0.0002; F = 43.48) and (P = 0.002; F = 53.8), respectively (tables 2 and 3), and for the following nymph presence inside flowers (P = 0.0001; F = 72.18) and (P = 0.007; F = 12.39), respectively (tables 4 and 5). These results indicate that PFT suppresses early season pear psylla egg laying activity (99-100% reduction in comparison to untreated control) and thus the density of psylla nymphs at flowering stage (99-100% reduction in comparison to untreated control). Lower, yet interesting, effectiveness was found with non-conventional mineral oil, which is not normally used in this early period (78-85% and 89-57% reduction in comparison to untreated control for the number of eggs observed and for the number of psylla nymphs counted during bloom, respectively).

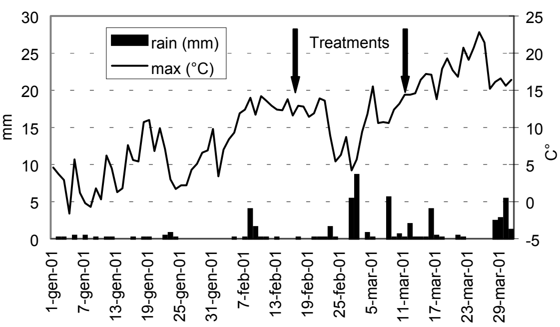

Figure 1a. Climatic conditions during 2001 trial.

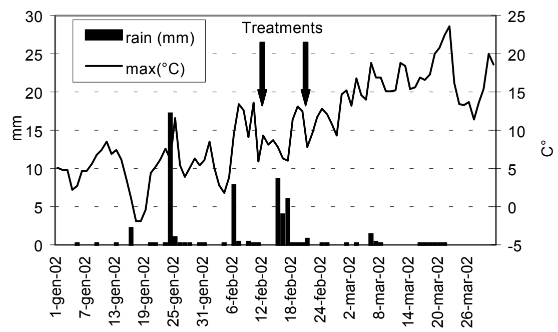

Figure 1b. Climatic conditions during 2002 trial.

Table 1. Treatment schedule.

no.	treatment	Dose %	no. treat.	Application time	treatment date 2001	treatment date 2002
1	untreated control	-	-	-	-	-
2	kaolin (Surround WP)	6	2	before egg laying and after rain	Feb. 18 and Mar. 10	Feb. 11 and Feb. 19
3	mineral oil	2.7	1	before egg laying	Feb. 18	Feb. 11

Table 2. Results for the sample of 100 buds per plot (March 19, 2001, when oviposition of overwintering females had stopped).

no.	treatment	average egg number per 100 buds (plot)	% reduction (Abbott)
1	untreated control	136.75 a	-
2	kaolin (Surround WP)	1 c	99
3	mineral oil	30 b	78

Table 3. Results for the sample of 100 buds per plot (March 11, 2002, when the oviposition of overwintering females had stopped).

no.	treatment	average egg number per 100 bud (plot)	% reduction (Abbott)
1	untreated control	77.75 a	-
2	kaolin (Surround WP)	0 c	100
3	mineral oil	12 b	85

Table 4. Results for the sample of 100 flowers per plot (April 13, 2001, when the nymphs were placed inside them).

no.	treatment	average nymph number per 100 flowers/plot	% reduction (Abbott)
1	untreated control	6 a	-
2	kaolin (Surround WP)	0.25 c	99
3	mineral oil	2 b	89

Table 5. Results for the sample of 100 flowers per plot (2 April 2002, when the nymphs were placed inside them).

no.	treatment	average nymph number per 100 flowers/plot	% reduction (Abbott)
1	untreated control	7.5 a	-
2	kaolin (Surround WP)	0 b	100
3	mineral oil	3.25 a	57

The presence of psylla feeding activity on flowers was only observed in the untreated control plots. This result should be important for several pear varieties (e.g. Doyenne du Comice) that are frequently damaged by psylla in that period. There were no differences in phytotoxic effects to pear leaves or fruits during the following season and between the fruit set observed in the treatment plots in comparison to that of the untreated ones.

Conclusions

Particle film technology using kaolin (Surround WP) affects egg laying of overwintering *C. pyri* by hindering their anchorage on the leaf surface and inhibiting host-plant acceptance (kaolin's mineral barrier). It was also found that the body and wings of some adults become soiled, rendering them less mobile and preventing them reaching the laying site (host location) on plants; indeed, the kaolin-treated plot was practically free of nymph instar. Further investigations will be carried out on a large scale to better define key aspects regarding the *C. pyri* spring populations, any side-effects on *A. nemoralis* and the relationships between the two species (prey/predator). Our overall results, like those reported in other studies, show that non-chemical kaolin is an effective insecticide without such side-effects on treated plants as fruit set and phytotoxicity.

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