

## Alternative to azadirachtin to control *Dysaphis plantaginea* Passerini (Hemiptera: Aphidae) in organic apple production

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### Abstract

The rosy apple aphid, *Dysaphis plantaginea* Passerini (Hemiptera: Aphidae), is a major pest of apple trees. In organic apple production, this aphid is commonly controlled by spraying azadirachtin, targeted against fundatrices in spring. However, this is the only active ingredient that has proved effective for the management of this pest in organic production, and therefore it would be desirable to provide other alternatives. In this study, several treatments (pyrethrins, garlic extract, kaolin, potassium salts of fatty acids, and defoliation) applied in autumn to prevent or reduce the presence of winged forms and oviparae in the trees were compared. In addition, applications of paraffin oil and lime sulphur in winter against rosy apple aphid eggs were tested. The trials were carried out in Catalonia (NE of Spain) from 2005 to 2010. The results showed that pyrethrins reduced the presence of rosy apple aphid oviparae but they did not have a knockdown effect. The time of application was crucial since the spring infestation was kept under control only when pyrethrins were sprayed throughout the period when oviparae were in the apple trees. It was demonstrated for the first time that pyrethrins sprayed in autumn can prevent outbreaks of rosy apple aphid and can therefore provide an alternative to azadirachtin.

**Keywords:** Rosy apple aphid, pest management, repeated measures analysis.

### Introduction

The rosy apple aphid (*Dysaphis plantaginea* Pass.) is a major pest affecting apples. In organic production, only azadirachtin satisfactory controls the pest when it is sprayed against fundatrices (Kienzle *et al.*, 1996; Schulz *et al.*, 1997). However, it is risky to rely on only one active ingredient to control a key pest as there is a high risk that resistance can develop. So the aim of this study is to assess alternatives to azadirachtin.

### Materials and methods

Trials were conducted from 2005 to 2010 in the experimental organic apple orchard in the IRTA-Experimental Station of Lleida located in Les Borges Blanques (Catalonia, NE Spain). Treatments with pyrethrins, garlic extract, kaolin, potassium salts of fatty acids and defoliation were compared to a non-treated control and were applied twice or three times in autumn. In addition, a single application of paraffin oil and lime sulphur were done in winter. Five experiments were conducted and the results of the previous year were used to adjust the treatments for the experiment in the subsequent year. The presence or absence of the rosy apple aphid was recorded in 20 shoots or flower buds per tree randomly selected in each assessment. In autumn, assessments were done weekly from mid-October till leaf fall. In spring, evaluations were carried out weekly from green cluster development stage until the end of rosy apple aphid migration from trees to plantain.

A multivariate repeated-measures analysis was used to evaluate the efficacy of the treatments throughout autumn and spring. The relationship between the percentage of infested flower buds or shoots in each of the previous weeks to the maximum and the

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maximum of infested shoots in spring was tested by linear regression analysis using the Pearson's correlation.

### Results and Discussion

The overall analysis of our results indicated that pyrethrins reduced the presence of rosy apple aphid oviparae. As oviparae are present in trees from the end of October until leaf fall, treatments must be applied throughout this period in order to prevent egg oviposition. In Experiment 1, all the products were applied during this interval and only pyrethrins and tree defoliation achieved effective control of the pest the following spring. In fact, defoliation prevented autumn rosy apple aphid colonisation since no winged forms of this aphid were found on trees after leaves were removed. However, the up-scaling of this practice in a commercial organic orchard is uncertain.

When pyrethrins were applied throughout the period in which oviparae were in the apple trees, the spring infestation was kept under control. However, three sprayings were required, and the attempts to reduce the number of applications or increase their efficacy by combination with paraffin oil or lime sulphur failed.

Kaolin, garlic extract, and potassium soap did not prevent autumn colonisation, and therefore did not control the pest in the following spring. However, the spring infestation of the trees sprayed with potassium soap was lower than control only from mouse-ear stage to three weeks after full bloom. Nevertheless, the results indicated that fundatrices are not a good indicator of control as there was no correlation between the percentage of infested flower buds and the maximum percentage of infested shoots. In fact, the maximum of infested shoots was only statistically correlated with the infestation from the end of petal fall onwards.

In this study, it was demonstrated for the first time that pyrethrins sprayed in autumn throughout the period when oviparae are on the apple trees can prevent outbreaks of rosy apple aphid. Pyrethrins can therefore be used as an alternative to azadirachtin to control this pest. It was found that the rosy apple aphid infestation at full bloom was not a good indicator of the efficacy of a product to control this pest. For this reason, assessments should not be done until it is certain that the maximum of infested shoots has been reached.

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