Non-chemical control of *Aphis spiraecola* patch. and *Dysaphis plantaginea* pass. on apple

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ABSTRACT

Non-chemical methods for control of the most important aphids on apple in Bulgaria, rosy apple aphid (*Dysaphis plantaginea* Pass.) and spiraea aphid (*Aphis spiraecola* Patch.), were evaluated under field conditions in the region of Plovdiv (Central-South Bulgaria). Two treatments with the kaolin containing product, Surround WP, applied in October, significantly reduced the number of winter eggs of *D. plantaginea*. Its effectiveness was comparable to that of the defoliation of apple trees. The botanical insecticides Neem Azal T/S (azadirachtin) and Pyretrum FS EC (pyrethrum) showed an excellent effectiveness against rosy apple aphid but were ineffective against spiraea aphid. The microbial insecticides Naturalis (*Beauveria bassiana*) and Preferal WG (*Paecilomyces fumosoroseus*) had a delayed initial effect. However, on five to seven days after treatment, these pesticides showed a very good effectiveness against *A. spiraecola* and excellent effectiveness against *D. plantaginea*.

Key words: Azadirachtin, *Beauveria bassiana*, defoliation, kaolin, *Paecilomyces fumosoroseus*, pyrethrum, rosy apple aphid, spiraea aphid

INTRODUCTION

Organic farming is a new, but already wide-spread, farming system in the world. It has a limited niche in the Bulgarian agriculture, albeit the interest towards it is increasing. The organic fruit production is one of the most attractive directions for Bulgarian farmers. However, serious difficulties appear, because of the long list of pests infesting the orchards along with the limited list of plant protection products permitted for use in this system. Biopesticides are products with a specific action. Many additional rules have to be observed when they are being applied. Researches on this issue in our country are insufficient.

Apple is one of the most popular fruit crops in Bulgaria. Apple orchards are, however, infested by many pests, as codling moth, scale insects, leaf-miner moths, mites, etc. Aphids are also dangerous pests. More than ten aphid species have been reported as apple pests in Bulgaria. The most important of them are: *Aphis pomi* Deg., *Dysaphis plantaginea* Pass., *D. devecta* Wlk. *Rhopalosiphum insertum* Wlk. and *Eriosoma lanigerum* Hsm. (Pelov, 1977; Grigorov, 1980) and the recently found, but already wide-spread spiraea aphid (*Aphis spiraecola* Patch.) (Andreev *et al*., 2007; Rasheva and Andreev, 2007).

Organically acceptable methods for control of apple aphids, mainly aimed at *Dysaphis plantaginea*, have been evaluated in Europe and in the USA as well. They included dormant oil sprays, azadirachtin and organic narrow range oil in foliage sprays. A predominant opinion is that azadirachtin should be combined with plant oils in order to be more effective (Höhn *et al*., 1996; Schulz *et al*., 1997; Bessin, 2008; UC, 2008).

The impact of treatments with the natural pyrethrin and the repellent kaolin to control the autumn forms of *Dysaphis plantaginea* was assessed in Switzerland and Belgium. A strategy was also developed for autumn control of dioecous aphids on apple in France (Wyss and Daniel, 2004; Romet, 2004). Höhn *et al*. (2003) tried to prevent mating between males and females on the trees by complete defoliation by hand at the end of September. The authors considered that with defoliation, rosy apple aphid could be controlled successfully. The aim of this study was to evaluate the efficacy of some non-chemical methods for control of the two most important aphids on apple in Plovdiv area (South-Central Bulgaria) - rosy apple aphid (*Dysaphis plantaginea* Pass.) and spiraea aphid (*Aphis spiraecola* Patch.).

MATERIALS AND METHODS

The experiments were carried out in the orchard of the Experimental Field of Department of Entomology of the Agricultural University of Plovdiv (Central-South Bulgaria) in the years 2006-2008. The tests included two insecticides based on plant extracts: NeemAzal T/S (azadirahtin) at the

concentration 0.3% or 0.5% and Pyrethrum FS (pyrethrin + sesame oil + soft potassium soap) at 0.05% or 0.1%; two insecticides based on microorganisms (fungi) – Naturalis[â] (*Beauveria bassiana*), used at 0.1% or 0.2% and PreFeRal WG (*Paecilomyces fumosoroseus*), applied at 0.1% or 0.2%, one kaolin containing product – Surround[â]WP and mechanical defoliation in autumn. The concentrations of biopesticides were established according to those indications at their registration for other pests.

Natural colonies of nymphs and wingless adults of both aphids – rosy apple aphid (*Dysaphis plantaginea* Pass.) and spiraea aphid (*Aphis spiraecola* Patch.) were treated with botanical and microbial insecticides. Five medium-sized colonies were used for each treatment, including control, treated with water. The number of surviving individuals was recorded – one, three, five and seven days after treatment.

Two other experiments were carried out in autumn aimed at preventing the return of remigrants of *D. plantaginea*. The treatment with kaolin containing repellent Surround[â] WP, in concentration of 3%, was applied as single or double applications on three different dates. Every variant included 10 apple trees, non-treated with chemical insecticides, placed in two neighbouring rows (Table 1). The treatments were started on 15.09, 01.10. and 15.10 and in 2006 were repeated 15 days after treatment. The results were evaluated in spring of the next year, by checking the incidence of colonies of aphids on branches of the treated and untreated trees. Full hand defoliation of trees, which were not treated with insecticides, was executed at the same three dates as the kaolin treatments. The design of the experiment and evaluation of results was also the same as for the experiment with Surround[â]WP.

RESULTS AND DISSCUSSION

Experiments with direct treatments of *Dysaphis plantaginea*

Pyrethrum FS showed flash action and resulted in a better control than any of botanical insecticides, tested against rosy apple aphid. The efficacy was 100% on the first day after treatment at both concentrations (Fig. 1). Based on these results, it has been suggested that the concentration of Pyrethrum FS applied against *D. plantaginea* might even be decreased (below 0.05%). The second botanical insecticide, NeemAzal T/S, was ineffective at the concentration 0.3%, but showed a good efficacy (around 90%) when used at the higher concentration – 0.5%. The action of this product was delayed and the good effect was reached on the third day after treatment.

The fungal insecticide Naturalis[â], applied at the concentration of 0.1% against rosy apple aphid, resulted in a satisfactory efficacy (over 80%) till the third day after treatment (Fig. 2). When used at a concentration of 0.2%, it showed a very high efficacy (over 90%) already on the first day after treatment. Later its efficacy raised over 95% and continued to increase till the last day of the trial. Another fungal insecticide Preferal WG had a poor action on the first day after treatment, but after the next two days reached the efficacy similar to Naturalis[â]. Later on its efficacy steadily increased, and even at the lower concentration (0.2%) exceeded 90%.

Experiments with direct treatments of *Aphis spiraecola*

Both botanical insecticides, Neem Azal T/S and Pyretrum FS EC, were ineffective against spiraea aphid, at the used concentrations (Fig. 3). Probably there are differences in

Figure 1. Efficacy of plant-based insecticide against nymphs and adults of *D. plantaginea* and *A. spiraecola*

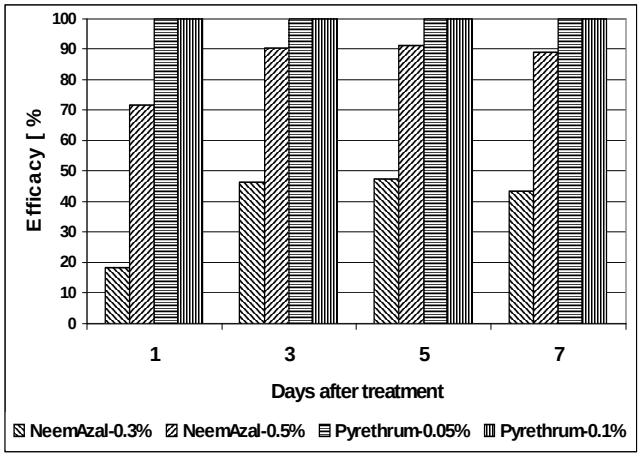


Figure 2. Efficacy of microbial insecticides against nymphs and adults of *D. plantaginea*

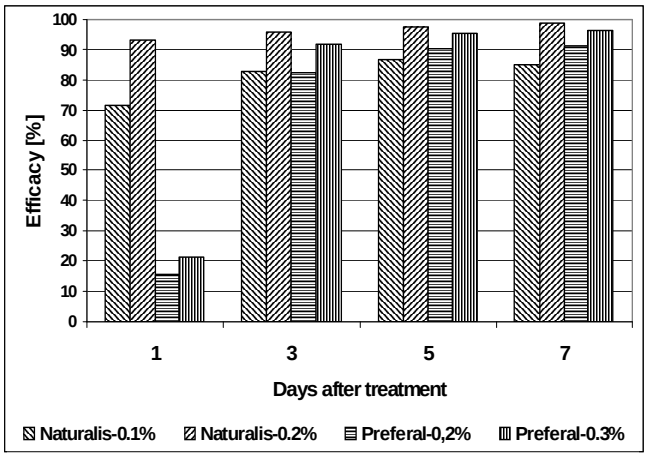


Figure 3. Efficacy of plant-based insecticide against nymphs and adults of spiraea aphid, *A. spiraecola*

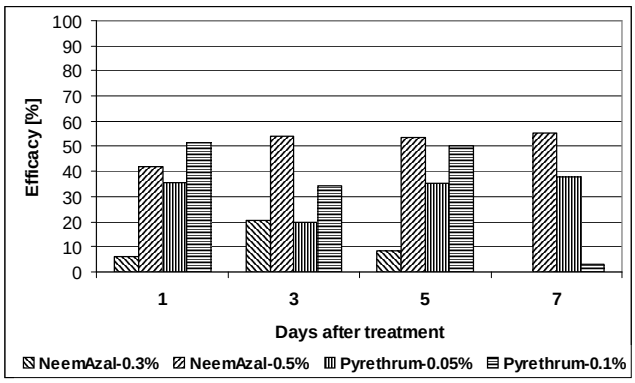
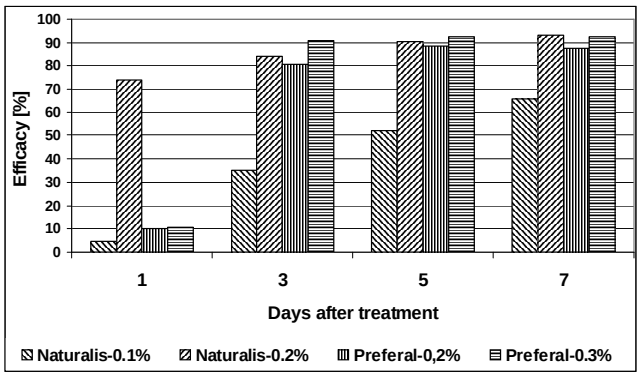


Figure 4. Efficacy of microbial insecticides against nymphs and adults of spiraea aphid, *A. spiraecola*



susceptibility of rosy apple aphid and spiraea aphid in relation to this kind of insecticides. Trying to use these insecticides in higher concentrations would be economically unjustified. Therefore, the search for another strategy of non-chemical control of *A. spiraecola* must be undertaken.

Application of fungal insecticides was more successful. The efficacy of Naturalis® was increasing from the first till the last day of the experiment. The results were unsatisfactory with the concentration of 0.1%, but at the concentration of 0.2% the efficacy exceeded 90% on the fifth and seventh day after treatment (Fig. 4). The insecticide Preferal WG was very efficient against *A. spiraecola*, despite its delayed action, used in the higher concentration (0.3%) even as early as on the third day after treatment, whereas in the lower concentration (0.2%) on the fifth day. The results obtained justify including both fungal insecticides under study into the programme of non-chemical control of the spiraea aphid.

Experiments on autumn treatments for control of *Dysaphis plantaginea*

The experiments with kaolin containing repellent Surround® WP were carried out in two consecutive years. The results corresponded with the data reported by Romet (2004); Bürgel *et al*. (2005). The repeated, double applications of Surround® WP (applied in the first year of study – autumn 2006) significantly reduced the number of females of rosy apple aphid in autumn and consequently the number of winter eggs and hatched fundatrices. The treated trees remained without any aphid colonies in the following spring (Table 1). Single kaolin treatments (employed in the second year – autumn 2007) were less effective. Aphid colonies were found on some trees in spring of the next year in all variants (dates of application of Surround® WP) albeit the aphid colonies were

Table 1. Effect of double or single autumn treatment of 0.3% Surround® WP against *Dysaphis plantaginea*

Trees in a row (by consecutive numbers) treated twice in 2006 and once in 2007, on different dates																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
treated in 2006 on 15.09 iand n 2007 on 15.09 and 30.09										treated in 2006 on 15.10 and in 2007 on 15.10 and 30.10									
control (untreated)					treated in 2006 on 01.10 and in 2007 on 01.10 and 16.10										**control (untreated)**					
Trees in a row (by consecutive numbers) with aphid colonies in spring (23.04.2007) after a double treatment in autumn 2006																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	+		+													+	+	+	+
Trees in a row (by consecutive numbers) with aphid colonies in spring (12.04.2008), after a single treatment in autumn 2007																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
+		+		+	+			+				+	+						
+	+		+				+	+	+		+						+	+	+
Legend: + trees with colonies of *D.plantaginea*																			

less numerous on the trees treated at the latest date, i.e. in the middle of October. After earlier applications trees were infested as heavily as the untreated control.

The experiments with defoliation by hand gave the result identical with the double treatments of Surround® WP. No colonies of *D. plantaginea* in spring of the next year were recorded on the trees defoliated in autumn at any date. The results of these experiments open an opportunity for another strategy for control of rosy apple aphid.

The botanical insecticides Neem Azal T/S (azadirachtin) in concentration 0.5% and Pyretrum FS EC (pyrethrum) in concentrations 0.05% or 0.1% show an excellent effectiveness against *Dysaphis plantaginea*, but were ineffective against *A. spiraecola*. The microbial insecticides Naturalis® (*Beauveria bassiana*) and Preferal WG (*Paecilomyces fumosoroseus*) had a delayed initial effect. However, starting from the fifth day after treatment, these pesticides showed a very good effectiveness against *A. spiraecola* and excellent effectiveness against *D. plantaginea*, when applied in concentrations 0.2-0.3%.Two treatments with kaolin containing product, Surround®WP, in October significantly reduced the number of winter eggs of *D. plantaginea* – as successfully as defoliation of apple trees. Single kaolin treatments were ineffective.

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